WILDLIFE AND WILDLIFE HABITAT LOSS ASSESSMENT AT DETROIT BIG CLIFF DAM AND RESERVOIR PKOJECT NORTH SANTIAM RIVER, OREGON

FINAL REPORT

By

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ABSTRACT

A habitat based assessment was conducted of the US. Army Corps of Engineers' Detroit/Big Cliff Dam and Reservoir Project (Detroit Project) on the North Santiam River, Oregon, to determine losses or gains resulting from the development and operation of the hydroelectric-related components of the project. Preconstruction, postconstruction, and recent vegetation cover types at the project site were mapped based on aerial photographs from 1939, 1956, and 1979, respectively. Vegetation cover types were identified within the affected area and acreages of each type at each time period were determined. Ten wildlife target species were selected to represent a cross-section of species groups affected by the project. An interagency team evaluated the suitability of the habitat to support the target species at each time period. An evaluation procedure which accounted for both the quantity and quality of habitat was used to aid in assessing impacts resulting from the project. The Detroit Project extensively altered or affected 6,324 acres of land and river in the North Santiam River drainage. Impacts to wildlife centered around the loss of 1,608 acres of conifer forest and 620 acres of riparian habitat. Impacts resulting from the Detroit Project included the loss of winter range for black-tailed deer and Roosevelt elk, and the loss of year-round habitat for deer, river otter, beaver, ruffed grouse, pileated woodpecker, spotted owl, and many other wildlife species. Bald eagle and osprey were benefited by an increase in foraging habitat. The potential of the affected area to support wildlife was greatly altered as a result of the Detroit Project. Losses or gains in the potential of the habitat to support wildlife will exist over the life of the project.

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I. INTRODUCTION

This loss statement addresses the impacts to wildlife resources resulting from the development and operation of the hydroelectric-related components (e.g., dam, reservoir) of the U.S. Army Corps of Engineers' (USACE) Detroit/Big Cliff Dam and Reservoir Project (Detroit Project). The study was funded by Bonneville Power Administration and was designed to meet requirements of Measure 1004(b)(2) of the Columbia River Basin Fish and Wildlife Program adopted by the Northwest Power Planning Council pursuant to Section 4(h) of the Northwest Electric Power Planning and Conservation Act of 1980.

The objectives of the study were to: 1) provide for consultation and coordination with interested parties, 2) identify probable effects of past development and operation of the Detroit Project on wildlife and wildlife habitat, and 3) determine the hydroelectric portion of the wildlife resource losses at the Detroit Project. A habitat based approach was used to identify effects of the project and to determine losses or gains in the potential of the project area to support wildlife.

II. STUDY AREA

A. Project Description

Detroit Dam is located at river mile 48.5 of the North Santiam River on the boundary between Marion and Linn counties, Oregon. The project is 45 miles southeast of Salem within the boundary of the Willamette National Forest (USACE 1982). Big Cliff Dam is located about 3 miles downstream from Detroit Dam. The Detroit Project is within the Oregon Department of Fish and Wildlife (ODFW) Santiam Wildlife Management Unit, and the Detroit Ranger District of the Willamette National Forest.

Detroit Dam is a concrete-gravity structure approximately 454 feet high, with a crest length of 1,522 feet. Power is generated by two 50,000 kilowatt turbines (USACE 1982). The surface area of Detroit Reservoir is 3,580 acres at full pool level. The reservoir is 10 miles long and has a maximum width of 1.4 miles. Maximum pool elevation is 1,574 feet and minimum power pool elevation is 1,425 feet.

Big Cliff Dam is a concrete-gravity dam, with a total length of 295 feet and maximum height of 172 feet (USACE 1953). Power is generated by one 18,000 kilowatt generator. The reservoir surface at full pool level is 2.8 miles long and covers an area of approximately 141 acres (USACE 1953). Maximum pool elevation is 1,210 feet and minimum power pool elevation is 1,182 feet (USACE 1980).

Construction of Detroit Dam was authorized by the Flood Control Act of 1938. Installation of power generation facilities, including construction of Big Cliff Reregulating Dam, was authorized by the Flood Control Act of 1948 (USACE 1954). Construction began in 1947. The power generators at Detroit and Big Cliff were in operation in 1953 and 1954 respectively. Reregulation at Big Cliff Dam began in 1953 (USACE 1982). The Detroit Project was considered complete in 1954, with the exception of minor modifications and improvements (USACE 1954).

B. Study Area Description

The "affected area" referred to in this report was most intensively studied and included that area directly affected by project construction and operation. This area encompassed the reservoir, project facilities, staging areas, and relocated roads. Areas not directly affected by the project, but within the range of species using the project area, were considered when determining qualitative impacts.

The Detroit Project is located in the Western Hemlock Zone described by Franklin and Dyrness (1973). The reservoir site was characterized by stands of Douglas-fir, western red cedar, and western hemlock. Deciduous trees (bigleaf maple, red alder, and Pacific dogwood) occurred throughout the area, particularly along water courses. Comnon understory vegetation included vine maple, ceanothus, elderberry, rhododendron, Oregon grape, and salal (USACE 1953). More detailed descriptions of vegetation cover types and acreages are provided in Section IV.A.l. of this report.

Black-tailed deer and probably Roosevelt elk wintered on the project site. Black bear, beaver, river otter, mink, muskrat, marten, raccoon, rabbit, and skunk also inhabited the reservoir area, as did blue and ruffed grouse, mallards, and mergansers (Oregon State Game Commission [OSGC] 1951, USACE 1953). Preconstruction information on nongame species was not documented. In addition to those species documented to be present prior to construction, the affected area potentially supported many more wildlife species (Appendix A).

C. Land Ownership

USACE is responsible for 478 acres of land adjacent to the reservoirs which are necessary for operational purposes. U. S. Forest Service (USFS) manages activities on the 3,580-acre water surface of Detroit Reservoir and administers 2,846 acres of project land contiguous to the reservoirs within the National Forest boundary (K. Beck, USACE, pers. comnun.). Most of the lands surrounding Big Cliff Reservoir are privately owned and managed as commercial forest lands (J. Rawstern, Linn Co., pers. comnun.; USACE 1981).

III. METHODS

A. Consultation and Coordination

A list of agencies and their representatives interested in participating in the consultation/coordination process was developed and updated throughout the study. Parties on this list received correspondence informing them of the project effort and of consultation/coordination meetings. Participating agencies and individuals were repeatedly contacted by phone or in person throughout the study. Meeting minutes, draft species lists, target species lists, vegetation cover type descriptions, acreage tables, habitat rating system descriptions, and sections of the draft report were provided to those agencies and individuals expressing interest in the loss assessment. Study procedures, species list, target species, vegetation mapping, and report drafts were

discussed at meetings and comments were requested and documented. Interested agencies were represented by participants in the habitat rating process (see Section 1II.E.).

B. Vegetation Cover Type Mapping

Preconstruction, postconstruction, and recent vegetation cover types of the Detroit Project area were mapped based on aerial photographs from 1939, 1956, and 1979 obtained from USACE in Portland. The 1979 photographs were both black and white and color infrared. Those from 1956 and 1939 were black and white. Scales varied from 1:10,200 to 1:30,000. The base map was derived from 1:62,500 USGS quadrangle maps, enlarged to 1:24,000 and screened on mylar film. The area mapped extended l/4 mile from the full pool reservoir shoreline. Vegetation cover types were based on categories described by Hall et al. (1985) and are described in section IV.A.l.

The aerial photographs were examined under a stereoscope and areas of discernibly similar vegetation cover were outlined (polygons) and labeled with a symbol designating cover type. These designations were checked against timber type maps obtained from the Willamette National Forest and photographs taken during site visits. The polygons on the overlays were then transferred to the base map using a camera lucida and by matching known landmarks and slope, ridge, and valley topography. An area on the upper Kinney Creek arm was not covered by 1939 aerial photography, and was mapped by extrapolation from the vegetation observed there on postconstruction and recent aerial photographs.

The recent map was ground truthed on 24 June 1985. Cover type categories designated on the map were visually verified and necessary changes were made to the draft recent map, then to postconstruction and preconstruction maps. All maps were then finalized and traced onto mylar overlays to the base map. A boundary including only the area directly affected by the project was determined from analysis of the aerial photographs and vegetation maps and was drawn on the base map. Acreages of map categories within the affected area boundary were calculated from blackline reproductions of the 3 maps, using the known area of the reservoir as a basis for assigning acreages to polygons. A digital planimeter was used to calculate areas of the polygons from which acreages were calculated. Polygon areas among the 3 maps agreed within 2.4%, and the area of the reservoir surface only differed by 1.5%, indicating good accuracy had been obtained.

C. Literature Review and Interviews

ODFW, USFS, and U.S. Fish and Wildlife Service (USFWS) files were examined for wildlife/habitat information relevant to the Detroit Project area. An extensive review of journal articles was conducted to locate research findings pertinent to the project area. Much of the available information on the status of wildlife populations during the preconstruction and postconstruction periods was identified in a status report on wildlife mitigation at the Detroit Project (Bedrossian et al. 1984). Interviews were conducted with ODFW, USFWS, and USFS biologists, and other individuals knowledgeable of wildlife/habitat conditions in the project area.

D. Target Species

Wildlife species potentially occurring in the project area (Appendix A) were identified based on a list of wildlife in the Willamette National Forest (USFS undated) and on the Oregon nongame wildlife management plan review draft (Marshall 1984). From these lists, target species were selected based on factors such as threatened or endangered Status, priority according to State or Federal programs, recreational or economic importance, or degree of impacts resulting from the project. Target species selected represent a cross-section of species groups (species that have similar habitat requirements) affected by the project and were used to evaluate the losses or gains in the potential of the project area to support wildlife.

E. Impact Analysis

The method used to aid in evaluating the loss or gain of wildlife habitat as a result of the Detroit Project was based on the "Habitat evaluation procedure" developed by USFWS (1976, 1980), "Ecological planning and evaluation procedures" developed by the Joint Federal-State-Private Conservation Organization Committee (1974), and discussions with various USFWS, USACE, and ODFW personnel.

The acres of cover types potentially used within the affected area by each target species were totaled to determine the habitat available at preconstruction, postconstruction, and recent time periods. Tables summarizing the cover types and acreages available to each target species were prepared. Habitat rating criteria worksheets providing information on habitat requirements were prepared for each target species and are available from ODFW. The worksheets provided a standard upon which ratings were based.

Participating agencies designated individuals having expertise in the project area and/or target species to attend the habitat rating meeting (Appendix B). Each person was provided with habitat rating criteria worksheets, drafts of background information sections of the loss assessment report, and tables of cover type acreages. Cover type maps and aerial photos were available and were consulted frequently during the rating session. The habitat rating group spent one day touring the project area, looking at habitat that was similar to that altered by the project, and discussing preconstruction, postconstruction, and recent habitat conditions as well as target species. At the rating session, acres of habitat available for each target species were agreed upon based on cover types, location, and other factors (e.g., forest stand condition) which might indicate whether an area was used as habitat. Once the available habitat was identified, the quality of the habitat at preconstruction, postconstruction, and recent time periods was rated on a scale of 1 to 10 (1=low quality habitat, 5=average quality habitat, 10=optimum habitat) for each target species. Ratings were derived from the site visit, aerial photographs, vegetation maps, habitat requirements of the target species, and biologists' expertise. Reasons for assigning each rating were documented and are discussed in this report. Factors other than hydroelectric development and operation that may have influenced the value of the habitats were considered but did not affect the assigned ratings unless otherwise noted in the text of this report.

The ratings for each target species at each time period were divided by the optimum habitat value (10) to provide a habitat suitability index. The habitat suitability index was then multiplied by the number of acres of habitat available to that species at that time period to determine habitat units (HU's) available. HU's provide a relative index of the importance of the habitat to that particular species. One HU is equal to one acre of optimum quality or prime habitat for that species.

HU's available to each target species prior to project construction were subtracted from available postconstruction HU's to determine the loss or gain in the potential of the habitat to meet the requirements of each target species. Preconstruction HU's also were subtracted from recent HU's to determine the loss or gain in the potential of the habitat to support the target species 23 years after project construction. When the number of HU's lost or gained at postconstruction was different from the number of HU's lost or gained at the recent time period, the reason for the difference (such as revegetation of an area that was disturbed during construction) was determined and documented. The HU's lost or gained represent the change in the potential of the habitat to support the given species at one point in time. That potential, however, was lost or gained over the entire life of the project. To simplify the loss assessment and loss/gain accounting process, the loss or gain at the recent time period was used in the report summary.

Other factors such as density estimates, impacts not directly affecting habitat quality, and impacts resulting from other causes were analyzed when information was available and are discussed in the text of this report. Losses incurred from construction and operation of the project were considered relative to benefits.

IV. RESULTS AND DISCUSSION

A. Vegetation Cover Types

1. Descriptions

Nineteen vegetation cover or land use types and 2 aquatic types were identified in the Detroit and Big Cliff areas and acreages within the affected area were calculated for each (Tables 1 and 2, Figures 1-3). The most abundant vegetation was conifer forest which was divided into 5 vegetation cover types: open and closed pole, open and closed sawtimber, and old-growth. The major tree species in all 5 was Douglas-fir. Western hemlock was an important component, and there were various inclusions of western red cedar, bigleaf maple, red alder, and madrone depending on moisture, slope, aspect, elevation, soils, and past disturbance. Crown closure and trunk diameter were the criteria used in distinguishing among the 5 conifer types.

a. Temperature conifer forest, open pole

Open pole stands, as described by Hall et al. (1985) are those where trees are taller than 10 feet, but canopy cover is less than 60% and maximum trunk diameter (dbh) is 9 inches. In this study, the assignment of this category and that of closed pole was made more on the basis of

Table 1. Acreages of cover types within the affected area[1] during preconstruction, postconstruction, and recent conditions, Detroit Reservoir, Oregon.

Vegetation Cover Type/ Map Category	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Loss or gain (-,+) Pre to Post-anstructicn	Pre to Recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	526	0	0	-526	-526
Temperate conifer forest, closed pole	403	65	43	-338	-360
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	106	106	+79	+77
Red alder	233	39	24	-194	-209
Shrubland	1,046	44	63	-1,002	-983
Grass-forb	297	207	27	-90	-270
Herbaceous wetland	10	4	17	-6	+7
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Sand/gravel/cobble	50	0	0	-50	-50
Residential/urban/ industrial	106	221	260	+115	+154
Agricultural, cropland	22	0	0	-22	-22
Agricultural, pasture	23	0	0	-23	-23
Rocky cliffs/talus	4	13	4	+9	0
Disturbed/bare	357	749	428	+392	+71
River	318	8	8	-310	-310
Reservoir	0	3,580	3,580	+3,580	+3,580
TOTAL	5,904	5,904	5,904		

[1] The "affected area" was the area directly affected by project construction and operation, and included the reservoir, project facilities, staging areas, and relocated roads.

Table 2. Acreages of cover types within the affected area[1] during preconstruction, postconstruction, and recent conditions, Big Cliff Reservoir, Oregon.

Vegetation Cover Type/Map Category	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Loss or gain (-,+) Pre- to Post-construction	Loss or gain (-,+) Preconstruction to recent
	Acres	Acres	Acres		
Temperate conifer forest, open pole	9	0	5	-9	-4
Temperate conifer forest, closed pole	30	2	2	-28	-28
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Red alder	82	10	59	-72	-23
Shrubland	21	15	7	-6	-14
Grass-forb	25	14	27	-11	+2
Riparian hardwood	20	0	0	-20	-20
Rocky cliffs/talus	3	3	3	0	0
Disturbed/bare	16	216	120	+200	+104
River	82	10	10	-72	-72
Reservoir	0	141	141	+141	+141
TOTAL	420	420	420		

[1]The "affected area" was the area directly affected by project construction and operation, and included the reservoir, project facilities, staging areas, and relocated roads.

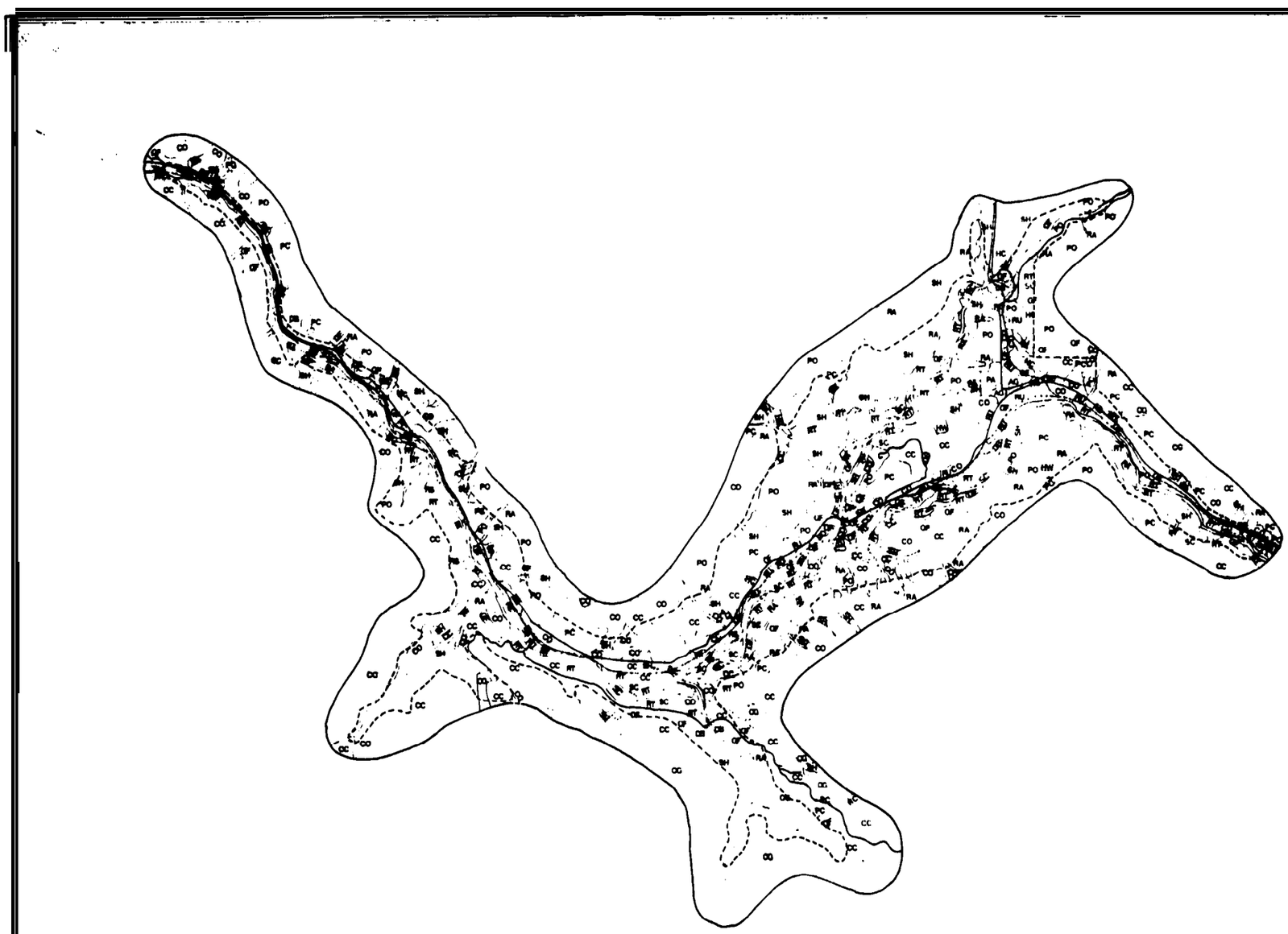

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Figure 1

Vegetation cover types of the Big Cliff and Detroit Reservoir areas: Preconstruction, 1939.

PO	Temperate conifer forest, open pole	RA	Red alder	RC	Rocky cliffs talus
PC	Temperate conifer forest, closed pole	SH	Shrubland	RU	Residential / urban / industrial
CO	Temperate conifer forest, open	GF	Grass-forb	AG	Agricultural
CC	Temperate conifer forest, closed	HW	Herbaceous wetland	PA	Pasture
CG	Temperate conifer forest, old growth	RB	Riparian shrub	DB	Disturbed / bare
HO	Conifer-hardwood (a -	wl	Riparian trees		River
HC	Conifer-hardwood forest, closed	SC	Sand / gravel / cobble		Affected area

N

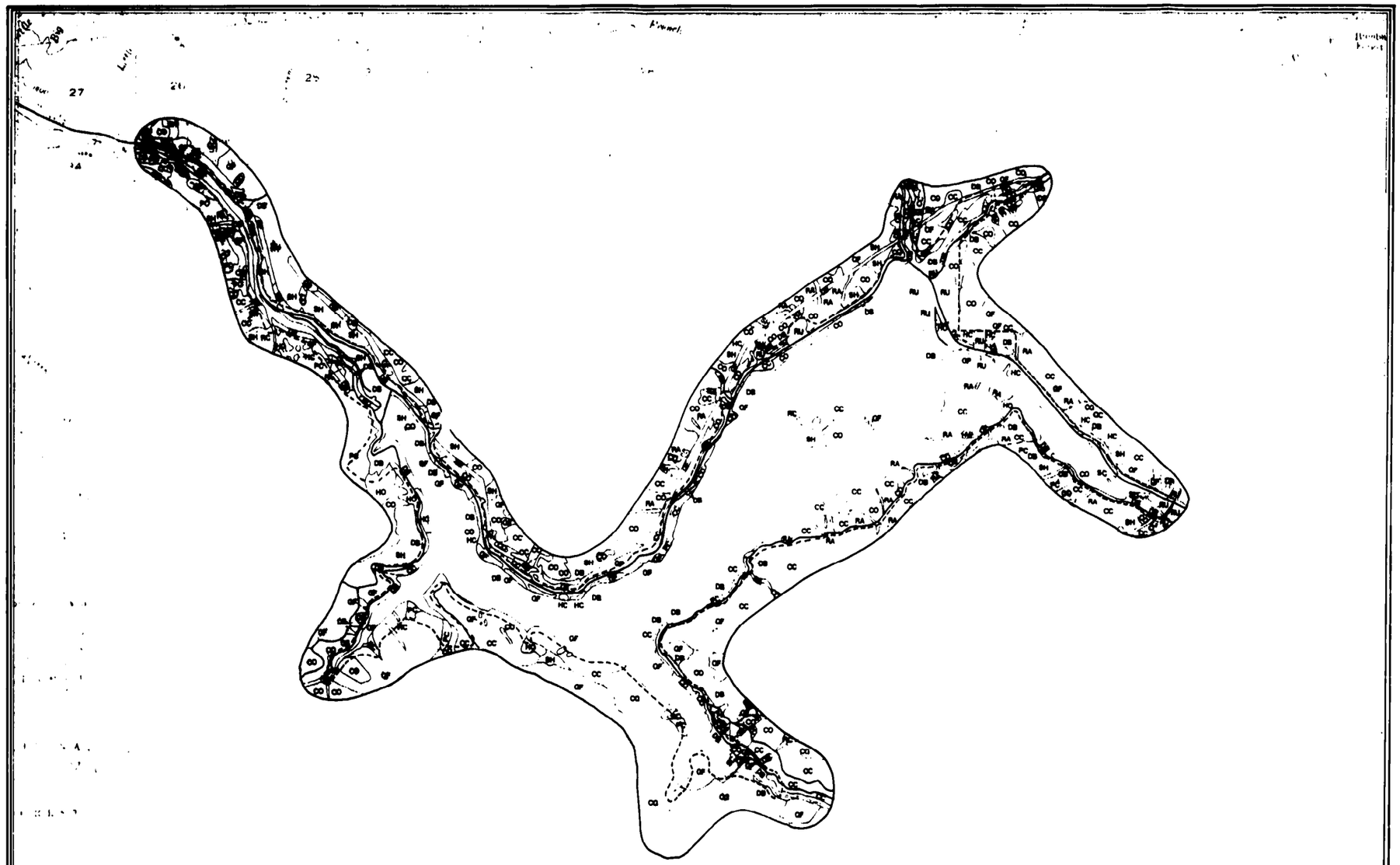

Figure 2

Vegetation cover types of the Big Cliff and Detroit Reservoir areas: Postconstruction, 1956.

PO	Temperate conifer forest, open pole	RA	Red alder	RC	Rocky cliffs / talus
PC	Temperate conifer forest, closed pole	SH	Shrubland	RU	Residential / urban / industrial
CO	Temperate conifer forest, open	GF	Grass-forb	AG	Agricultural
CC	Temperate conifer forest, closed	HW	Herbaceous wetland	PA	Pasture
CG	Temperate conifer forest, old growth	RS	Riparian shrub	DB	Disturbed / bare
HO	Conifer-hardwood forest, open	RT	Riparian trees		River
HC	Conifer-hardwood forest, closed	BC	Sand / gravel / cobble		Affected area

N

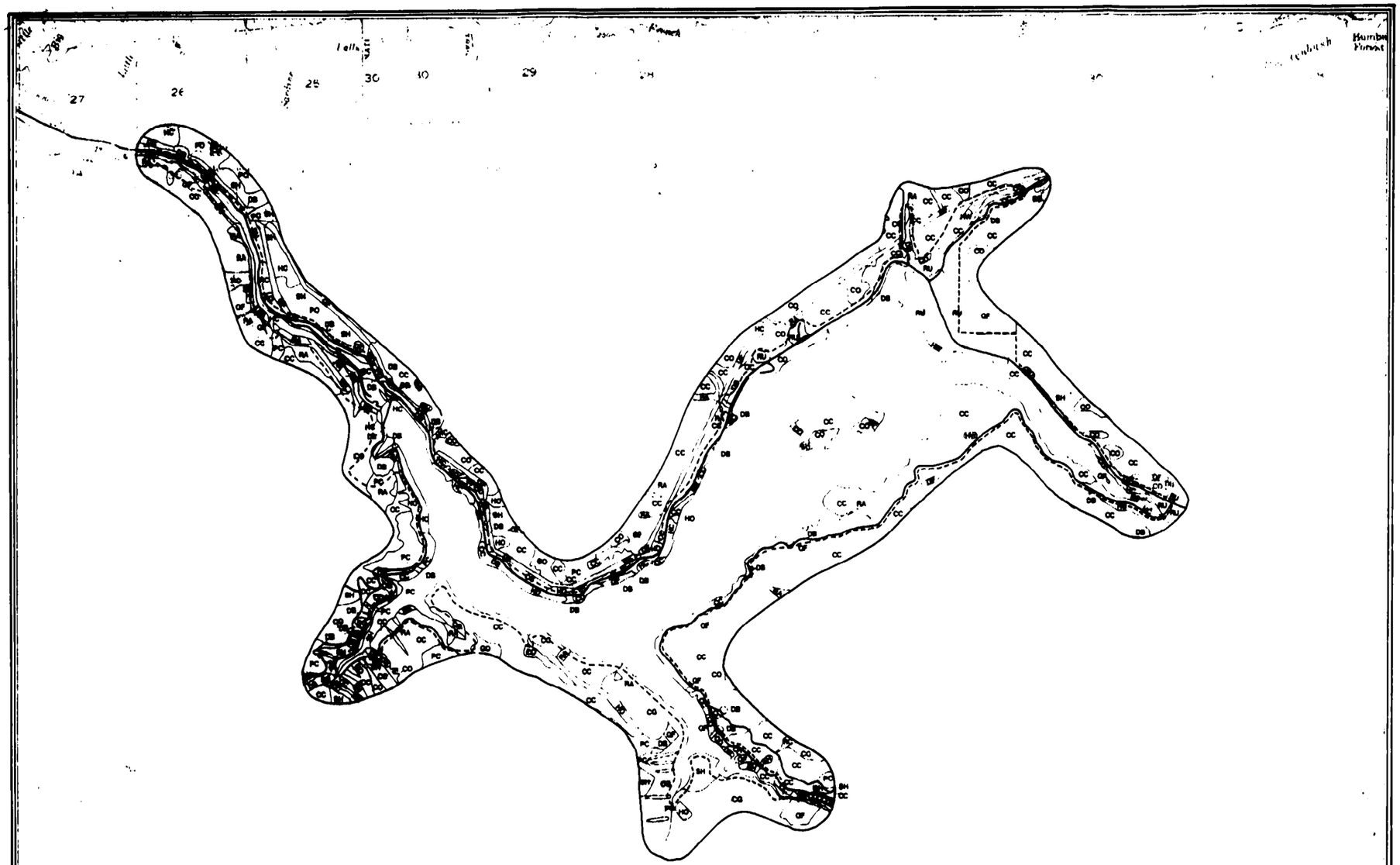

Figure 3

Vegetation cover types of the Big Cliff and Detroit Reservoir areas: Recent, 1979.

PO	Temperate conifer forest, open pole	RA	Red alder	RC	Rocky cliffs / talus
PC	Temperate conifer forest, closed pole	SH	Shrubland	RU	Residential / urban / industrial
CO	Temperate conifer forest, open	GF	Grass-forb	AG	Agricultural
CC	Temperate conifer forest, closed	HW	Herbaceous wetland	PA	Pasture
CG	Temperate conifer forest, old growth	RS	Riparian shrub	DB	Disturbed / bare
HO	Conifer-hardwood forest, open	RT	Riparian trees		River
HC	Conifer-hardwood forest, closed	BC	- 1 - 1 -		Affected area

N

small trees versus large trees. Stands where trees were obviously young and which appeared to be somewhat larger than tall shrubs were mapped as pole stands. Open pole stands often occurred on steep or south-facing slopes where growing conditions were apparently less than optimum. Ground cover was sparse and comprised of mostly low shrubs and herbs. Rock outcrops and bare ground were commonly seen on the aerial photographs. Prior to construction, there were extensive open pole stands along the hillsides above Big Cliff Reservoir and along the upper slopes south of the Breitenbush River at Detroit. Most of these were apparently the result of one of the many fires that occurred in the area. They comprised about 8% of the affected area before construction and less than 1% after construction.

b. Temperate conifer forest, closed pole

Stands of closed pole conifer forest had crown closure greater than 60%. Understory vegetation was sparse or lacking, due to the closed canopy. Most of the closed pole stands were on the south side of Big Cliff Reservoir. They appeared to have been regeneration of clear-cuts which occurred between 1956 and 1979. Closed pole stands accounted for about 7% of the vegetation of the affected area before construction and less than 1% after construction.

C. Temperate conifer forest, open sawtimber

Open temperate conifer forest stands of trees greater than 9 inches dbh comprised about 11% of the affected area prior to construction and less than 1% after construction. Within the entire mapped area, they were more abundant, occurring on steep slopes with rocky outcrops. Most of the open sawtimber stands within the affected area had well developed understories, with rhododendron, vine maple, salal, and seedling trees among the more common understory vegetation. Occasional inclusions of what appeared to be remnants of old-growth timber are included in this map category. Most consisted of scattered trees standing well above the existing stands. Large stumps were evidence of past logging. Crown closure was less than 70%.

d. Temperate conifer forest, closed sawtimber

Crown closure in stands of closed sawtimber (>9 inches dbh) was greater than 70%, except for inclusions of open sawtimber too small to map. Understory vegetation consisted of seedling western hemlock, rhododendron, vine maple, and other shade tolerant species. Closed sawtimber stands were the most abundant vegetation cover type within the affected area in 1979, but were less abundant in 1956 and 1939. This reflects the maturation of pole and shrub stands. The affected area consisted of 17% closed sawtimber stands before construction and 9% after construction. They had increased in extent to 17% by 1979.

e. Temperate conifer forest, old-growth

Most of the old-growth timber in the Detroit Reservoir study area was found on the upper Blowout Creek arm. Even in 1939, it was evident that extensive logging had taken place over a long period. Fires, including a major burn in 1919 (Rarey 1984), had periodically burned large areas

of the region and probably had destroyed a major portion of old-growth which remained after logging. Old-growth stands were characterized by decay, numerous snags, canopy openings, and abundant dead and down woody material. Overstory trees were large, usually greater than 21 inches in diameter, and the tree canopy often-consisted of 2 or more stories (Hall et al. 1985). Old-growth comprised 3% of the affected area before construction and less than 1% after construction.

f. Conifer-hardwood forest, open

These stands were mixtures of conifers and hardwoods, with the latter contributing 30-70% of total crown cover. Red alder was the most common hardwood, although bigleaf maple and madrone were also present. Open conifer-hardwood stands were not common within the study area and occurred mostly where disturbance had opened the canopy of existing closed conifer-hardwood stands. None were noted on 1939 aerial photographs, and after construction they accounted for less than 1% of the vegetation of the affected area.

9. Conifer-hardwood forest, closed

Like the open conifer-hardwood forest, these were stands of mixed hardwoods and conifers. They occurred along steep water courses as well as on hillsides. They did not appear to be stable communities, for the most part, but rather represented a seral stage in the development of conifer forest. Within the study area, red alder apparently competed very well with Douglas-fir in the early stages of regrowth, particularly on lower river terraces and gently sloping hillsides. Douglas-fir would eventually overtop the red alder, giving a stand the appearance, on aerial photographs, of being nearly pure conifer. The affected area contained less than 1% closed conifer-hardwood forest before construction and 3% after construction.

h. Red alder

Small scattered stands of red alder were common within the affected area, comprising 5% of the vegetation before construction and less than 1% after construction. They occurred along steep water courses and, before construction, on the lower river terraces, often adjacent to riparian stands. Red alder stands were distinguished from riparian stands by location in relation to the river or by topography, since riparian hardwood stands were also generally dominated by red alder. Hall et al. (1985) distinguished between red alder (dryland) stands and red alder riparian stands by the presence of water. In this study, where red alder occurred adjacent to the rivers or on lower reaches of tributary streams where slopes were slight to moderate, it was mapped as riparian. Where it occurred along the reservoir, on higher, steeper streambanks, terraces or hillsides, and in narrow steep valleys, it was mapped as red alder woodland. Red alder stands often included Douglas-fir and other conifers, but they did not contribute substantially to canopy cover. Bigleaf maple was also a common component of red alder stands, and black cottonwood occurred frequently but not abundantly. However, in all cases, red alder comprised at least 70% of the crown canopy.

i. Shrubland

The affected area contained 7% shrubland before construction and less than 1% after construction. Shrub communities had 40% or more woody crown cover, but woody vegetation was less than 15 feet tall (Hall et al. 1985). Most shrub communities were dominated by seedling conifers and were a seral stage in the regeneration of the temperate conifer forest. Shrubland north of Detroit, prior to construction, was the result of a fire that occurred before 1939. Other areas on all 3 maps were either old burns or regenerating clear-cuts.

j. Grass-forb communities

Most of the grass-forb communities mapped in the Detroit and Big Cliff study area were regenerating clear-cuts or burns and were the first stage in revegetation of disturbed areas. Those downslope of the roads around the reservoir were cleared as part of construction activities and were dominated by weedy species thereafter. Those along transmission line corridors were subject to vegetation management practices which prevented normal successional changes. Woody plant cover was less than 40% (Hall et al. 1985). Tree seedlings were usually present. A few grass-forb communities were in forest clearings or rocky outcrops and generally lacked tree seedlings or shrubs. Most of these were probably stable communities where shallow soil or other environmental factors contributed to maintenance of the grass-forb community. The grass-forb cover type comprised 5% of the affected area prior to construction, 3% directly after construction, and less than 1% in 1979.

k. Herbaceous wetland

Two herbaceous wetlands were identified on preconstruction aerial photographs of the Big Cliff and Detroit reservoir areas. One, just northeast of Piety Knob, was inundated by Detroit Reservoir; the other showed no change over the period of photography. They both appeared to be wet or subirrigated meadows and as such were probably dominated by sedges, rushes, and grasses. Three herbaceous wetlands were identified on 1979 aerial photographs of the Detroit Reservoir area. They occupied fairly level areas where the reservoir level appeared to be at or near the soil surface during much of the growing season. Reed canary grass and shrubby willows were the major species in the 3 areas. Herbaceous wetlands comprised less than 1% of the affected area before and after construction.

l. Riparian shrub

This map category was restricted to shrubby areas along the streams and on sand and gravel bars. It comprised less than 1% of the affected area both prior to and after construction. Vegetation consisted of seedling willow, black cottonwood, and red alder, with scattered herbaceous cover. Many of the riparian shrub stands should be considered ephemeral, as they occurred where high water could erode them before they had a chance to develop into tree communities. A few stands might endure to develop into riparian hardwood comunities, depending on flood frequency and channel changes.

m. Riparian hardwood

Red alder woodlands, where they occurred along stream banks, were designated as riparian hardwood communities. Black cottonwood and bigleaf maple were often present, as were conifers. At Detroit and Big Cliff reservoirs, riparian hardwood communities occurred along the rivers and in the lower reaches of major tributary streams. Before construction, extensive stands of riparian hardwoods were found along both the North Santiam and Breitenbush rivers, accounting for 9% of the vegetation of the affected area. None appeared on 1956 aerial photographs, but in 1979 they occurred on a few gently sloping stream banks on the upper reaches of Detroit Reservoir and at the mouths of a few large tributaries in areas too small to map. They were therefore included in the red alder map category.

n. Sand/gravel/cobble

These areas occurred along the river and lower reaches of the larger tributary streams and were probably under water during spring runoff and other periods of high water. They may have supported sparse herbaceous growth, but did not show signs of being heavily vegetated on aerial photographs. They comprised about 2% of the affected area prior to construction.

0. Residential/urban/industrial

This map category included the town of Detroit, rural residences and outbuildings, the Detroit Ranger Station, and industrial areas such as sawmills and log scaling stations.

p. Agricultural, cropland

There were few agricultural areas within the Big Cliff and Detroit Reservoir areas. All were near the preconstruction town of Detroit. Some small orchards were mapped as residential or agricultural croplands because they seldom consisted of more than a few trees and were too small to map separately.

q. Agricultural, pasture

Pastures were distinguished from croplands by the presence of trees or shrubs and the lack of obvious evidences of regular cultivation. They were just north of the preconstruction town of Detroit.

r. Rocky cliffs/talus

Only a few of the many rocky cliffs within the Big Cliff and Detroit Reservoir areas are shown on the maps. This is because they were extremely steep and did not show in vertical projection. Talus slopes generally occurred where seasonal runoff cut into steep hillsides, leaving paths free of vegetation. Often these bare areas became revegetated.

s. Disturbed/bare

This map category included disturbance caused by construction of the Detroit and Big Cliff dams and reservoirs, as well as other areas where human disturbance had altered the landscape. Most of the latter were along roads or near developed areas. The affected area contained 6% of this map category prior to construction, 15% directly after construction, and 9% in 1979.

t. River

The area in this category included the North Santiam and Breitenbush rivers as well as the lower portion of Blowout Creek. Other tributaries were too narrow to show up on the map and/or aerial photographs. River comprised over 6% of the affected area prior to construction, but less than 1% after construction.

U. Reservoir

The area mapped as reservoir included the full pool level of the reservoir. The drawdown zone, with a maximum vertical range of 149 feet, is exposed during lower water levels. Fluctuating water levels have not been conducive to the establishment of vegetation within this zone. Reservoir comprised 61% of the affected area at Detroit and 34% at Big Cliff.

2. Changes resulting from the project

Detroit and Big Cliff reservoirs inundated 3,721 acres. The actual land base lost was, of course, greater than the reservoir surface acreage. Over 12 miles of the North Santiam River and an undetermined number of miles of tributary streams were inundated. Surrounding land was altered by relocated roads, project facilities, and construction activities. Cover types reduced in acreage were riparian hardwood, open and closed sawtimber conifer forest, shrubland, old-growth conifer forest, grass-forb, red alder, sand/gravel/cobble, and river (Tables 1 and 2). More (Tables 1 and 2). More pole and sawtimber size conifer forest (1,431 acres) was eliminated than other cover types. Approximately 997 acres of shrubland habitat were lost. Approximately 598 acres of riparian hardwood stands were eliminated within the area directly affected by the Detroit Project. Riparian vegetation associated with rivers and streams is considered to be of importance by wildlife managers. Riparian habitat is generally thought to provide for higher density and diversity of wildlife than most other habitats. In addition, a reduction of riparian habitat downstream from the project may have occurred as a result of the Detroit Project and/or effects of the Willamette Reservoir System. Approximately 177 acres of old-growth conifer forest were lost. Extensive logging and fires in the project area resulted in less than 3% of the affected area being comprised of old-growth conifer forest prior to construction. Old-growth forests in the Pacific Northwest support diverse and abundant wildlife populations and provide optimum habitat for up to 18 bird and mammal species (Meslow et al. 1981). The reduction of old-growth stands in the Pacific Northwest is of serious concern to wildlife managers. The effects of the loss of the

previously mentioned cover types within the area directly affected by the project is discussed in greater detail in the Target Species sections of this report.

Cover types which increased within the affected area included conifer-hardwood forest, herbaceous wetland, reservoir, and disturbed/bare. As a result of natural revegetation and succession during the years following project construction, disturbed/bare, grass-forb, and open sawtimber conifer forest developed into closed sawtimber conifer forest, conifer-hardwood forest, shrubland, and red alder on over 600 acres of the area surrounding the reservoir.

Changes have occurred in the Willamette Basin since the time of project construction as a result of increased timber harvest and increased human development. It was not possible to estimate how much of the area directly affected by the project might have been re-logged or when logging may have occurred if the project had not been constructed. Timber management plans for the area prior to project construction could not be found. It is not possible to say how management of the area would have been different without the project. The potential to manage the area for wildlife, however, would still exist if the project had not been constructed. Because the project was constructed, the potential for the inundated area to support many species of wildlife was eliminated.

B. Target Species

1. Roosevelt elk

a. Importance

The Roosevelt elk is a major big game species in western Oregon. Approximately 51,216 hunters participated in seasons for Roosevelt elk in 1983. The Santiam Wildlife Management Unit, in which the project is located, provided 22,153 hunter-days of recreation during the 1983 elk hunting seasons (Ingram 1984). Roosevelt elk require a variety of habitat types for survival, from open areas to old-growth forest (Witmer et al. 1985). The Roosevelt elk was chosen as a target species for this study because of ODFW management emphasis, recreational value, loss of winter range due to the project, and to represent other species with similar habitat requirements.

b. Habitat requirements

Open areas such as clear-cuts or burned areas, and natural openings found along streams or in old-growth forests provide elk forage such as grasses, forbs, and shrubs (Mace 1956, Swanson 1970, Cleary 1976, Witmer and decalesta 1983). Critical to elk use of open forage areas is the proximity to cover. Elk use of open areas begins to decrease beyond 200 feet from cover and decreases rapidly beyond 600 feet (Witmer et al. 1985). Forest stands provide escape cover as well as thermal relief from temperature extremes (Mace 1956; Harper 1966, 1971; Witmer and decalesta 1983). Sapling-pole forests provide security during hunting seasons and thermal relief during warm summer months (Mace 1956, Witmer

and decalesta 1983). Old-growth forests provide reduced snow depths and maintenance forage during severe winter weather, in addition to escape and thermal cover (Starkey et al. 1982, Witmer and decalesta 1983, Witmer et al. 1985). Snow depths of 18 inches or more can impede elk movement and bury most forage in forest openings, therefore, old-growth stands are particularly important to elk during winter periods of deep snow (Witmer et al. 1985). Riparian habitats characterized by mixed conifer and hardwood vegetation are important foraging, loafing, traveling, and watering areas (Starkey et al. 1982, Witmer and decalesta 1983).

Use of plant species for forage varies with the seasons. Green grasses and forbs are heavily used by Roosevelt elk in spring and summer. Browse species are more important in late summer, fall, and winter (Mace 1956; Harper 1966, 1971). Vegetation use depends upon availability, but several species such as huckleberry, vine maple, salal, ceanothus, willow, and blackberry are important foods for Roosevelt elk (Mace 1956; Harper 1966, 1971; Swanson 1970; R. Jubber, ODFW, E. Harshman, USFS, pers. communs.).

C. History in the project area

Elk were widespread throughout the Willamette Valley during the 1800's. Settlement and unrestricted hunting had decimated the elk population by 1900 (Mace 1956, Starkey et al. 1982). Beginning in 1905, elk hunting was not permitted in Oregon. By the mid-1930's, elk damage complaints indicated some populations of elk could support a limited harvest, and in 1938 Roosevelt elk were hunted for the first time since the closure (Mace 1956).

Estimates made of the Oregon elk population in 1932 indicated 800 animals in the Cascade Range and 25 elk within Linn County (OSGC 1933). No estimates were made for Marion County. In 1953, OSGC initiated a program to increase the number and distribution of Roosevelt elk in western Oregon (Mace 1971). By 1967, the estimated Roosevelt elk population in the Willamette Basin was 2,000 animals, the majority of which were found in the McKenzie and Middle Fork Willamette River drainages (Aney 1967). The increase in elk numbers is mostly attributed to the increase in timber harvest in the Willamette Basin at that time.

Information is limited on elk populations in the project area prior to construction. The importance of the area as critical winter range, however, is supported by snow depth records that indicate depths greater than 18 inches during 9 of the 22 years from 1949-72 (USFS files). During the severe winter of 1968-69, 200-300 elk were present in the Breitenbush drainage (J. Heintz, ODFW, pers. commun.). Approximately 15-20 elk currently winter at the mouth of Blowout Creek on the south side of Detroit Reservoir.

d. Assessment of impact

(1) Detroit

Prior to project construction, over 5,000 acres of habitat were available to elk for winter use within the affected area (Table 3). Primary

Table 3. Roosevelt elk: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Preconstruction to recent
Temperate conifer forest, open pole	526	0	0	-526	-526
Temperate conifer forest, closed pole	403	65	43	-338	-360
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Shrubland	1,046	44	63	-1,002	-983
Grass-forb	297	207	27	-90	-270
Red alder	233	39	24	-194	-209
Agricultural, cropland	22	0	0	-22	-22
Agricultural, pasture	23	0	0	-23	-23
Herbaceous wetland	10	4	17	-6	+7
TOTAL ACRES	5,069	1,333	1,624	-3,736	-3,445
Habitat Rating	5	1	2		
HABITAT UNITS	2,535	133	325	-2,402	-2,210

cover types were conifer forest, riparian hardwood, shrubland, grass-forb, and red alder. Foraging areas were plentiful but high quality thermal cover was lacking because of fires and logging in the project area. Old-growth forest (204 acres) provided cover and maintenance forage and, along with riparian hardwoods, contributed to the importance of the area for survival during severe winters. The presence of the town of Detroit reduced the habitat quality somewhat. The value of this area as elk winter range was rated 5 (average) by the interagency evaluation group. Following the impact analyses methods described in Section III. E., the rated value of the habitat (5) was divided by the optimum value (10), resulting in a habitat suitability index of 0.5. The suitability index was then multiplied by the number of acres of habitat available (5,069), resulting in a habitat unit (HU) value of 2,535. One HU is equivalent to 1 acre of optimum habitat, therefore, the 5,069 acres of elk habitat within the affected area prior to construction were equivalent to 2,535 acres of prime elk habitat.

Upon completion of project construction, 1,333 acres of habitat were available to elk within the affected area (Table 3). The most significant losses were in thermal cover represented by conifer forest and riparian hardwood cover types. Large acreages of foraging habitat were also lost. The interagency evaluation group rated the postconstruction habitat for elk 1 (low). Project construction activity and associated disturbance reduced elk use of remaining cover and forage areas at the Detroit site. The relative value of the postconstruction elk habitat in the affected area was 133 HU's, a loss of 2,402 HU's from the preconstruction value.

By 1979, 1,624 acres of habitat were available to elk (Table 3). The increase in habitat was due to natural revegetation and seral advancement in the affected area. The value of the habitat as winter range was rated 2 (poor) by the evaluation group. Despite the increase in potential habitat, the value remained low because most of the thermal cover within the affected area was on north slopes in steep topography. Human recreational use and highway traffic limited elk use of the area. The value of the elk habitat was 325 HU's, a loss of 2,210 HU's when compared to the preconstruction value.

(2) Big Cliff

Prior to project construction, 319 acres of habitat were available to elk within the affected area (Table 4). The evaluation group rated the preconstruction habitat for elk 3 (below average), for a value of 96 HU's. The steep topography of the area limited use of the habitat to serving as a migration corridor, which was particularly important during severe winters.

After completion of the project, 50 acres of minimum quality habitat were available to elk within the affected area (Table 4). The steep topography precluded most use by elk and the habitat was rated 1 (low), for a value of 5 HU's. This was a loss of 91 HU's from the preconstruction value.

Table 4. Roosevelt elk: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	9	0	5	-9	-4
Temperate conifer forest, closed pole	30	2	2	-28	-28
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Shrubland	21	15	7	-6	-14
Grass-forb	25	14	27	-11	+2
Red alder	82	10	59	-72	23
TOTAL ACRES	319	50	146	-269	-173
Habitat Rating	3	1	1		
HABITAT UNITS	96	5	15	-91	-81

By 1979, habitat available to elk had increased to 146 acres (Table 4). The lowest possible rating (1) was again given, which resulted in a HU value of 15, or a decrease of 81 HU's from preconstruction conditions.

(3) Summary of impacts

Over 3,600 acres of critical winter range and 2,291 HU's for Roosevelt elk were lost as a result of the Detroit Project. The decline in HU's for Roosevelt elk represents a loss in the potential of the project area to support elk and other wildlife species with similar habitat preferences or requirements.

The relocated roads adjacent to Detroit and Big Cliff reservoirs carry logging traffic and provide access to recreationists. In addition to the loss or degradation of habitat, these roads can result in increased incidences of road kills or poaching, increased disturbance and hence greater energy expenditures, or total avoidance of the area by elk and deer.

2. Black-tailed deer

a. Importance

Black-tailed deer are pursued by more hunters than any other big game species in western Oregon. Deer hunting provided 157,205 hunter-days of recreation in the Santiam Wildlife Management Unit during 1983 (Ingram 1984). Black-tailed deer prefer a variety of habitat types, from open areas to old-growth forest (Witmer et al. 1985). With inundation of the Detroit and Big Cliff sites, year-round habitat and important deer winter range was lost. The black-tailed deer was chosen as a target species for this study because of ODFW management emphasis, recreational value, loss of habitat due to the project, and to represent other species with similar habitat requirements. The black-tailed deer is a major big game species in Oregon and has different specific habitat requirements and preferences than elk. Therefore, black-tailed deer were selected as a target species in addition to Roosevelt elk, even though many basic habitat requirements are similar.

b. Habitat requirements

Black-tailed deer are associated with open areas, such as burns, clear-cuts, and natural openings found along streams or in old-growth forests, as well as brush and edge habitat (Mace 1953, Aney 1967). These areas produce the grasses, forbs, and shrubs upon which deer forage. The value of these forage areas for deer is dependent upon the proximity to cover. Black-tailed deer remain near the edge between cover and open areas. Deer use of open forage areas increases from the edge to 200 feet from cover, then gradually decreases beyond 200 feet, and decreases rapidly beyond 600 feet (Wilms 1971, Witmer et al. 1985). Hanley (1983) observed peak deer use of open forage areas approximately 550 feet from cover. Old-growth forest stands are used by deer for hiding cover and during adverse weather conditions for supplemental forage and thermal cover (Lindzey 1943, Witmer et al. 1985). Old-growth stands are,

therefore, especially important to deer during periods of deep snow, when depths of 18 inches or more impede deer movement and bury most forage in forest openings (Witmer et al. 1985). Riparian zones provide water, forage, and shade, and are used as travel corridors by black-tailed deer. Riparian habitat receives greater use during fawning periods, dry summer months, and times of heavy snowfall (Witmer et al. 1985).

Forage species used by black-tailed deer vary with the season and availability. Wallmo (1981) conducted a study west of Corvallis, Oregon, and found that browse species were most frequently used, forb use increased in spring and summer, and grasses were consumed consistently in winter. Browse species such as trailing blackberry, huckleberry, and salal are important to black-tailed deer in the Coast Range (Lindzey 1943; Brown 1961; Miller 1966, 1968; Hines undated). The primary browse for black-tailed deer in the Cascade Range is ceanothus. The most important species of ceanothus are deerbrush, redstem, and snowbrush (R. Jubber, ODFW, pers. commun.). Some of the highest quality deer winter ranges in the central and south Cascades contain one or more of these species (E. Harshman, USFS; R. Jubber, ODFW, pers. commun.).

C. History in the project area

Information on deer populations in the project area prior to construction is limited. OSGC estimated 5 deer per square mile along the North Santiam River in 1948 (OSGC and Fish Commission of Oregon 1948). That estimate was probably much lower than actual densities due to the inadequacy of estimation procedures used during 1948 (J. Heintz, ODFW, pers. commun.).

The area inundated by the reservoirs and the south slopes north of the project were key winter range for black-tailed deer (Moore 1984). USACE (1953) estimated "habitat for about 30 deer . . . will be destroyed by the impoundments." Local residents recall high deer mortality at Detroit Reservoir the winter after flooding (R. Shull, USFS, pers. commun.), indicating its importance as winter range. Dozens of deer carcasses were observed above the Detroit Ranger Station during the winter of 1953-54 (Rarey 1984).

The deer population in the Willamette Basin peaked between 1955 and 1960 (Aney 1967). In 1967, the estimated black-tailed deer population in the Willamette Basin was 135,000 (Aney 1967). ODFW estimated the 1980 black-tailed deer population in Linn and Marion counties was 31,600 and 13,000 animals, respectively. With approximately 2,000 square miles of deer habitat within Linn County, the estimated density was 16 deer/square mile of habitat (ODFW files). The 895 square miles of deer habitat in Marion County indicated an estimated density of 15 deer/square mile of habitat. Current winter deer density estimates in the Detroit area may range as high as 60-80 deer/square mile (J. Heintz, ODFW, pers. commun.).

d. Assessment of impact

(1) Detroit

The same cover types available to elk during preconstruction were assumed to be available to black-tailed deer (Table 5). The evaluation team rated the 5,069 acres of deer habitat 7 (above average), resulting in a value of 3,548 HU's. Cover:forage ratios were nearly ideal and the availability of forage was near optimum for deer. Although much of the available cover was on fairly steep slopes, it was extremely important during the critical winter period. The high mortality after inundation of the reservoir site indicated the importance of the area. Deer migrated up and down the North Santiam drainage, which was used as a travel corridor prior to construction.

In 1956, upon completion of the project, 1,333 acres of black-tailed deer habitat remained within the affected area (Table 5). Forage may have been provided in the recently disturbed areas, but little thermal cover was available. Postconstruction habitat was rated 1 (low). A loss of 3,415 HU's resulted from construction of the project, with the remaining habitat having a value of 133 HU's.

Black-tailed deer habitat increased to 1,624 acres by 1979 as a result of natural revegetation (Table 5). The evaluation team rated this habitat 3 (below average) which resulted in 487 HU's. This was a loss of 3,061 HU's compared with the preconstruction value. The available habitat within the affected area occurred on steep slopes and lacked high quality winter thermal cover. Human activity reduced the value of habitat available to black-tailed deer within the affected area.

(2) Big Cliff

At Big Cliff Reservoir, 319 acres of habitat were available to deer prior to construction (Table 6). The habitat was rated 3 (below average), resulting in a value of 96 HU's. Little cover was available, although deer used the south slopes during winter.

Fifty acres of habitat rated 1 (low) remained in 1956 after construction (Table 6). A loss of 91 HU's resulted from construction of the project.

Natural revegetation resulted in an increase of black-tailed deer habitat to 146 acres by 1979 (Table 6). The quality of this habitat, however, was still rated 1 (low) by the evaluation team. Some forage was provided; however, the steep topography limiteduse of the area except during severe winters. The 15 HU's present in 1979 represented a loss of 81 HU's from preconstruction conditions.

(3) Summary of impacts

The Detroit Project resulted in the loss of 3,618 acres of key winter range and 3,142 HU's for black-tailed deer. The decline in HU's for deer represents a loss in the potential of the project area to support deer and other wildlife species with similar habitat preferences or requirements.

Table 5. Black-tailed deer: Acres of habitat available and lost, habitat ratings, and habitat at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	526	0	0	-526	-526
Temperate conifer forest, closed pole	403	65	43	-338	-360
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Shrubland	1,046	44	63	-1,002	-983
Grass-forb	297	207	27	-90	-270
Red alder	233	39	24	-194	-209
Agricultural, cropland	22	0	0	-22	-22
Agricultural, pasture	23	0	0	-23	-23
Herbaceous wetland	10	4	17	-6	+7
TOTAL ACRES	5,069	1,333	1,624	-3,736	-3,445
Habitat Rating	7	1	3		
HABITAT UNITS	3,548	133	487	-3,415	-3,061

Table 6. Black-tailed deer: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	9	0	5	-9	- -4
Temperate conifer forest, closed pole	30	2	2	-28	-28
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Shrubland	21	15	7	-6	-14
Grass-forb	25	14	27	-11	+2
Red alder	82	10	59	-72	-23
TOTAL ACRES	319	50	146	-269	-173
Habitat Rating	3	1	1		
HABITAT UNITS	96	5	15	-91	-81

3. River otter

a. Importance

Furbearers documented as using the reservoir site prior to project construction included river otter, beaver, mink, marten, muskrat, raccoon, and skunk (OSGC 1951, USACE 1953). The river otter was selected as a target species for this study because of its economic and recreational value, dependence on aquatic and riparian habitat, loss of habitat as a result of the Detroit Project, and to represent other species with similar habitat requirements.

b. Habitat requirements

The river otter is a semiaquatic mammal dependent upon water and its associated riparian habitat for food, cover, and reproduction (LaDue 1935, Mace 1979, Deems and Pursley 1983). River otters use streams and mountain rivers ranging from 3-33 yards wide (Maser et al. 1981, Melquist and Hornocker 1983). During winter, otters seek fast-flowing streams free of ice (Mace 1979). Mudflats, open marshes and swamps, and backwater sloughs are used more often by otters during summer (Melquist and Hornocker 1983).

River otters use abandoned burrows of other animals as den sites (Mace 1979, Rue 1981, Toweill and Tabor 1982). Beaver houses or dens are used most often; muskrat houses and dens are also used (Mace 1979, Rue 1981, Toweill and Tabor 1982). These dens are usually renovated and enlarged by otters (Ingles 1965, Maser et al. 1981). Dens selected by river otters may be as far as 1/2 mile from water (Maser et al. 1981, USFS 1981 a). Parturition may occur in dens or cavities among roots of trees, brushpiles, thickets of vegetation, under streambanks, or in hollow stumps or logs (Liers 1951, Mace 1979).

Principal food of the river otter is fish (Rue 1981, Toweill and Tabor 1982, Deems and Pursley 1983). They are opportunistic feeders and select those fish species most abundant and/or easiest to catch (Toweill and Tabor 1982, Melquist and Hornocker 1983). Crayfish are an important year-round item in the diet of river otters (Maser et al. 1981, Toweill and Tabor 1982, Deems and Pursley 1983). In addition to fish and crayfish, the diet includes amphibians, aquatic insects, small mammals, birds and eggs, and carrion. River otters also eat some vegetation such as berries, tubers, pondweeds, algae, and grasses (Sheldon and Toll 1964, Maser et al. 1981, Rue 1981, Toweill and Tabor 1982) .

C. History in the project area

River otters formerly occupied nearly all permanent streams and lakes in Oregon (Mace 1979). Unregulated trapping was permitted until 1913, at which time the Oregon Legislature enacted comprehensive trapping laws for 5 species of furbearers, including river otters (Mace 1979).

River otters still occupy much of their original range but in lesser numbers due to reduced habitat and increased trapping pressure (Aney

1967, Mace 1979). In 1967, the river otter population in the Willamette Basin was estimated at 500 animals (Aney 1967). In 1980 the estimated otter population in Linn County was 145 animals over 290 linear stream miles (290 square miles) of habitat (ODFW files). In Marion County the 1980 estimate was 140 otters over 190 stream miles. Quantitative information on river otter populations in the project area prior to construction was not available.

d. Assessment of impact

(1) Detroit

The habitat evaluation team assumed the conifer-hardwood, riparian shrub and hardwood, herbaceous wetland, red alder, sand/gravel/cobble, and river cover types (1,245 acres) were available to river otters within the affected area prior to project construction (Table 7). This habitat was given a suitability rating of 8 (high) and a value of 996 HU's. Food was adequate and supplied by spring chinook smolts, trout, and nongame fish. The habitat met cover and denning requirements of river otters.

Following completion of the project, 562 acres of habitat were available to river otters (Table 7). This included 10% of the reservoir area used for foraging, primarily within the tributaries and along the shoreline. The evaluation team assumed that approximately 10% of the reservoir area would be used by river otters. The largest loss of habitat was of riparian hardwood and river cover types. The suitability of the habitat remaining in 1956 was rated 1 (low) by the evaluation team. Disturbance of the area had recently occurred and vegetation had not yet begun to recover. The dam and reservoir inhibited river otter movement along the North Santiam River. The value of the postconstruction otter habitat within the affected area was 56 HU's, a loss of 940 HU's from the preconstruction value.

Habitat available to river otters within the affected area totaled 569 acres in 1979 (Table 7). The value of the habitat was rated 2 by the evaluation team, still poor but slightly improved over postconstruction conditions. Fish and crayfish probably provided an adequate food supply, but the exposed reservoir shoreline did not provide adequate cover or denning sites. Present conditions for furbearers are not favorable due to pool fluctuations (USACE 1953). Human activity had a negative effect on river otters, which was probably increased by the lack of cover in the reservoir area. The river otter habitat in 1979 was valued at 114 HU's, a loss of 882 HU's from the preconstruction value.

(2) Big Cliff

Riparian hardwood, red alder, and river cover types (184 acres) were available to river otters within the area affected by Big Cliff Reservoir (Table 8). This habitat was rated 7 (above average) for a value of 129 HU's at preconstruction. Healthy fish populations and a series of riffles and pools provided good forage conditions and denning habitat appeared adequate.

Table 7. River otter: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Herbaceous wetland	10	4	17	-6	+7
Red alder	233	39	24	-194	-209
Sand/gravel/ cobble	50	0	0	-50	-50
River	318	8	8	-310	-310
Reservoir*	0	358	358	+358	+358
TOTAL ACRES	1,245	562	569	-683	-676
Habitat Rating	8	1	2		
HABITAT UNITS	996	56	114	-940	-882

*Represents 10% of the reservoir area

Most of the 166 acres of habitat available to river otters after project construction was comprised of the reservoir (Table 8). The evaluation team considered all of the reservoir as available habitat because it was relatively narrow. The lack of anadromous fish and disturbance of adjacent vegetation were factors in assessing a rating of 3 (below average) and a value of 50 HU's at postconstruction.

An additional 61 acres of red alder and conifer-hardwood forest cover types were available to river otters by 1979 (Table 8). Although food resources were adequate within the affected area, the extreme water level fluctuation, human and highway disturbance, and general lack of shoreline vegetation contributed to a rating of 4 (below average). The 91 HU's available in 1979 represented a loss of 38 HU's from preconstruction conditions.

3. Summary of impacts

The loss of 920 HU's and 633 acres of habitat for river otters at the Detroit and Big Cliff sites represents a loss in the potential of the project area to support otters and other wildlife species with similar habitat preferences or requirements.

Research conducted in Idaho indicated Cascade Reservoir was virtually unused by river otters because there was insufficient escape cover and resting sites along the exposed shoreline even though there was a sufficient food source (Melquist and Hornocker 1983). The study also indicated that otters' tolerance of human activity was related to the amount of escape cover and shelter along a lake shoreline. The study concluded that river otters preferred stream-related habitats to lakes, reservoirs, and ponds because of the availability of shelter and escape cover and reduced disturbance.

4. Beaver

a. Importance

Beaver have an important place in Oregon's history, so much so that the species was selected as the state animal. Fur trade attracted the first settlers to the Oregon territory, and beaver are still of economic value today. Beaver are dependent upon a relatively stable source of water and its associated riparian habitat for survival where they create ponds and pools used by many species of fish and wildlife for rearing, feeding, and nesting. The beaver was selected as a target species for this assessment because of historic and economic value, dependence upon riparian habitat, loss of habitat due to the project, and to represent other wildlife species with similar habitat requirements.

b. Habitat requirements

Slow-flowing streams, small streams or lakes well wooded with deciduous trees, and some agricultural waterways and wetlands may be selected for colonization by beaver (Aney 1967, Mace 1979, Deems and Pursley 1983). A minimum of 0.5 miles of stream channel or 0.5 square miles of lake or marsh habitat must be available before an area is suitable for beaver

Table 8. River otter: Acres of habitat availble and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-anstructicn (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Red alder	82	10	59	-72	-23
River	82	10	10	-72	-72
Reservoir	0	141	141	+141	+141
TOTAL ACRES	184	166	227	-18	+43
Habitat Rating	7	3	4		
HABITAT UNITS	129	50	91	-79	-38

colonization (Allen 1982). Beaver need a permanent and relatively stable water source (Allen 1982). Stream gradient, which may be the most significant factor in determining suitability of riverine habitat for beaver, must be less than 15% (Allen 1982). Beaver construct dams to stabilize water depths (Shay 1978, Mace 1979) and to create ponds which provide cover, feeding, and reproductive requirements (Rue 1981, Allen 1982, Deems and Pursley 1983).

A deciduous tree and/or shrub canopy closure of 40-60% is an indication of optimum food availability for beaver (Allen 1982). For maximum suitability, the diameter at breast height (dbh) of trees should range from 1-6 inches, and shrubs should be at least 6-1/2 feet tall (Allen 1982). Tree species used include aspen, willow, cottonwood, alder, red osier dogwood, birch, maple, cherry, and poplar (Townsend 1953, Mace 1979, Allen 1982). Beaver feed primarily on the bark and cambium layer of deciduous trees and shrubs, as well as the twigs and leaves. Small quantities of Douglas-fir, western hemlock, and Scotch broom also are consumed (Maser et al. 1981). The majority of foraging occurs within 330 feet of the water's edge and may extend to distances of 660 feet (Allen 1982). Aquatic vegetation is preferred by beaver, and herbaceous vegetation appears to be preferred over woody vegetation (Allen 1982). Sedge and water lily rhizomes are consumed during summer (Seton 1953, Townsend 1953, Allen 1982).

Beaver construct dens which fulfill their cover and reproductive needs (Allen 1982). Three basic forms of dens are constructed by beaver: a standing lodge in open water, a bank lodge with a burrow into the bank, and a burrow into the bank without a lodge (Ingles 1965, Allen 1982).

C. History in the project area

Quantitative information on furbearer populations in the project area prior to construction was not available. The reservoir site supported beaver, river otter, mink, marten, muskrat, raccoon, and skunk (OSGC 1951, USACE 1953).

Historical records indicate the Willamette Basin supported large beaver populations when the earliest trappers and explorers arrived in the early 1800's (Aney 1967). Beaver trapping in Oregon was restricted by a statewide closure in 1899 and did not resume until 1951 (Kebbe 1960, Shay 1978). Beaver populations had become seriously depleted due to over-trapping and habitat losses (Kebbe 1960, Shay 1978). In 1932, a program was begun to live trap beaver from damage sites or areas of healthy populations and transfer them to suitable habitat in an effort to reestablish beaver in their historical habitat (Scheffer 1941, Kebbe 1960, Shay 1978). The Willamette Basin beaver population in 1967 was estimated at 10,000 (Aney 1967).

d. Assessment of impact

(1) Detroit

Prior to inundation 1,245 acres of riparian shrub, riparian hardwood, red alder, herbaceous wetland, conifer-hardwood, sand/gravel/cobble, and

river were available to beaver within the affected area (Table 9). The evaluation team rated the habitat 6 (above average), resulting in a value of 747 HU's. Hardwoods and herbaceous vegetation within the affected area, along with an abundance of willows which resulted from fire-related succession, provided adequate forage. Some backwater and slough habitat was also available.

Upon completion of the project, beaver habitat was reduced to 311 acres (Table 9). This included 107 acres of reservoir (3% of the full pool surface). The evaluation team felt that beaver would not range far from shore and assumed that approximately 3% of the reservoir area was available habitat. Postconstruction habitat was rated 1 (low). Few or no forage species were available and the area was recently disturbed. Water level fluctuations precluded use of denning sites and human recreational use limited the suitability of the tributaries. The habitat was valued at 31 HU's, a loss of 716 HU's from the preconstruction value.

Habitat conditions were essentially the same in 1979 and were rated 1, resulting in a value of 32 HU's. This represented a loss of 715 HU's from preconstruction to recent conditions. The reservoir was considered poor beaver habitat by the evaluation team. Lakes and reservoirs having extreme fluctuations in water level are considered unsuitable beaver habitat (Allen 1982). Seventeen acres of herbaceous wetlands were available to beaver. The major impact of the project was the loss of riparian hardwoods, the major food source for beaver.

(2) Big Cliff

The 184 acres of habitat available to beaver prior to inundation were given a rating of 4 (below average) (Table 10). The steep, rocky terrain throughout much of the affected area limited the suitability, as did disturbance arising from the road and railroad along the canyon bottom. Preconstruction habitat was valued at 74 HU's.

After construction of the project, 60 acres of habitat rated 1 (low) were available to beaver (Table 10). This included 35 acres of reservoir (25% of the full pool surface). The evaluation team believed 25% of the reservoir was potential habitat compared with 3% at Detroit Reservoir because of the relatively narrow width of Big Cliff Reservoir. Recent fires had resulted in a loss of much of the vegetation. The 6 HU's present in 1956 represented a loss of 68 HU's from preconstruction conditions.

Natural revegetation increased the more recent (1979) available beaver habitat to 121 acres (Table 10). This habitat was given a rating of 2, (poor) resulting in a value of 24 HU's, or a loss of 50 HU's from preconstruction to recent conditions. A small amount of forage was available along the south shore and tributaries.

(3) Summary of impacts

The Detroit Project resulted in the loss of 990 acres and 765 HU's for beaver. As was noted for other lakes and reservoirs (Allen 1982),

Table 9. Beaver: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Herbaceous wetland	10	4	17	-6	+7
Red alder	233	39	24	-194	-209
Sand/gravel/ cobble	50	0	0	-50	-50
River	318	8	8	-310	-310
Reservoir*	0	107	107	+107	+107
TOTAL ACRES	1,245	311	318	-934	-927
Habitat Rating	6	1	1		
HABITAT UNITS	747	31	32	-716	-715

*Represents 3% of the reservoir area

Table 10. Beaver: Avres of habitat availale and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-anstructicn (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Red alder	82	10	59	-72	-23
River	82	10	10	-72	-72
Reservoir'	0	35	35	+35	+35
TOTAL ACRES	184	60	121	-124	-63
Habitat Rating	4	1	2		
HABITAT UNITS	74	6	24	-68	-50

*Represents 25% of the reservoir area

extreme water level fluctuations rendered much of the remaining habitat unsuitable for beaver. The decline in HU's for beaver at the Detroit and Big Cliff sites represents a loss in the potential of the project area to support beaver and other wildlife species with similar habitat preferences or requirements.

5. Common merganser

a. Importance

The common merganser was chosen as a target species because of the effects of the project on nesting and wintering habitat, and to represent other wildlife species with similar habitat requirements.

b. Habitat requirements

Swift streams and large lakes of the Cascade Mountains in Oregon provide either breeding or wintering habitat for several species of waterfowl. Among the species most likely to breed in the Detroit area are common mergansers. Common mergansers typically nest in cavities and prefer deciduous riparian habitat in later forest stages (USFS 1981b). Gabrielson and Jewett (1940) reported that common mergansers nested along swifter streams and shores of larger lakes throughout Oregon.

Foods consumed by common mergansers include fish and fish eggs, aquatic invertebrates, frogs, newts, and some aquatic plants (Bellrose 1976, USFS 1981b). Mergansers forage in clear water 1-1/2 to 6 feet deep and eat a wide variety of fishes depending upon the species' availability.

C. History in the project area

Quantitative information was not available on waterfowl populations in the project area prior to construction. Common mergansers occurred on streams in the general area around Detroit and probably used the North Santiam River in the project area prior to construction.

USFWS, USFS, and ODFW do not conduct waterfowl counts on Detroit or Big Cliff reservoirs. ODFW reported that Detroit Reservoir has low potential for waterfowl use because of the drawdown and filling periods (Denney 1982).

d. Assessment of impact

(1) Detroit

Habitat available to common mergansers prior to project construction consisted of 1,012 acres of conifer-hardwood forest, riparian shrub and hardwoods, herbaceous wetland, sand/gravel/cobble, and river (Table 11). The suitability of this habitat was rated 7 (above average). The riparian zone provided nesting habitat and human disturbance was low. Anadromous and resident fish within the affected area provided a good forage base. The value of preconstruction habitat for common mergansers was 708 HU's.

Table 11. Common merganser: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Herbaceous wetland	10	4	17	-6	+7
Sand/gravel/ cobble	50	0	0	-50	-50
River	318	8	8	-310	-310
Reservoir	0	3,580	3,580	+3,580	+3,580
TOTAL ACRES	1,012	3,745	3,767	+2,723	+2,745
Habitat Rating	7	3	5		
HABITAT UNITS	708	1,124	1,884	+416	+1,176

After construction of Detroit Dam and Reservoir, 3,745 acres of common merganser habitat were available in the affected area. The increase in habitat was a result of the 3,580-acre reservoir. River habitat (310 acres) and riparian habitat (605 acres) used for foraging and nesting by common mergansers were lost (Table 11). Disturbance from construction had recently occurred and the fish resource probably had not stabilized by 1956. The suitability of this habitat was rated 3 (below average), for a HU value of 1,124.

By 1979, habitat available to common mergansers in the affected area consisted of 3,767 acres. An average rating (5) was given, which resulted in a HU value of 1,884 or an increase of 1,176 HU's from pre-construction conditions (Table 11). Forage was available year-round and the reservoir served as a resting area during winter. Hardwoods along the south shore and along tributaries provided nesting habitat.

(2) Big Cliff

The 102 acres of habitat available to common mergansers prior to construction of Big Cliff Reservoir (Table 12) supplied most of their habitat requirements. Anadromous and resident fish were present, and the riparian hardwoods and river bank provided nest sites. A rating of 6 (above average) resulted in a value of 61 HU's for the preconstruction habitat.

As a result of project construction, common mergansers lost river and riparian habitat and the associated potential foraging and nesting areas. Although an additional 141 acres of reservoir were available, the lack of an established fish population and general disturbance in the area resulted in a rating of 1 (low) and a value of 16 HU's for the postconstruction habitat.

By 1979, the quality of the habitat had increased slightly and was given a rating of 3 (below average). A forage base was present and nest sites were available. The habitat was generally adequate except for the disturbance from the highway and human activity. The 50 HU's available in 1979 represent a loss of 11 HU's from preconstruction.

(3) Summary of impacts

The Detroit Project resulted in the gain of 1,165 HU's and 2,811 acres of habitat for common mergansers, most of which are reservoir acres used for foraging and resting. River habitat used for foraging and riparian habitat used for nesting was lost. The increase in HU's represents a gain in the potential of the project area to provide foraging and resting areas for common mergansers and other wildlife species with similar habitat preferences or requirements.

6. Ruffed grouse

a. Importance

Upland game birds potentially affected by construction of the Detroit Project included ruffed grouse, blue grouse, mountain quai 1, and band-

Table 12. Common merganser: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
River	82	10	10	-72	-72
Reservoir	0	141	141	+141	+141
TOTAL ACRES	102	156	168	+54	+66
Habitat Rating	6	1	3		
HABITAT UNITS	61	16	50	-45	-11

tailed pigeon. The ruffed grouse was chosen as a target species because of recreational value, impacts resulting from the loss of riparian habitat, and to represent other species with similar habitat requirements.

b. Habitat requirements

Thickets of alder, hawthorn, birch, maple, and other deciduous trees provide summer and fall habitat for ruffed grouse in Oregon (Masson and Mace 1974). Adjacent conifer stands are used for escape cover and winter shelter.

Spring, summer, and fall diets of ruffed grouse in Oregon consist of a wide variety of leaves, grasses, forbs, berries, and buds (Durbin 1979). The availability of a winter source of birch, alder, hazel, or aspen catkins may be the most important factor influencing the survival of wintering ruffed grouse (Gullion 1966). In Oregon, Durbin (1979) reported that alder buds and catkins were probably the primary winter food. Black cottonwood (buds, twigs, catkins) and buttercup are the primary winter food items of ruffed grouse in western Washington (Brewer 1980).

Ruffed grouse chicks for the first 7-10 days primarily consume invertebrates (Johnsgard 1973), which are most available in mesic conditions such as found in riparian habitat. Ruffed grouse broods use semi-open areas characteristic of early stages of woodland succession (Sharp 1963). Small hardwoods, shrubs, berry bushes, and lush herbs provide habitat preferred by ruffed grouse broods (Bump et al. 1947). Once ruffed grouse chicks reach about 4 months of age, closed canopy forests are suitable habitat (Chambers and Sharp 1958).

Drumming sites are an important reproductive requirement of ruffed grouse. Drumming habitat may be either deciduous or mixed forest adjacent to fields, clear-cuts, or regrowth areas (Brewer 1980). Adequate nesting habitat is another reproductive requirement of ruffed grouse. Hardwood stands or mixed hardwoods are the most frequently used forest types for nesting (Edminster 1947, Maxson 1978). Nest sites are most often at the base of large trees, but some are located at the base of stumps, logs, or bushes, usually within 50 feet of clearings or fields (Edminster 1947).

C. History in the project area

Quantitative information on grouse populations in the project area prior to construction was not available. The OSGC estimated 3 grouse per square mile in the North Santiam watershed in 1948. That estimate was probably very low for the Detroit area during the late 1940's (J. Heintz, ODFW, pers. commun.). Current grouse density estimates in the project area are approximately 10 per square mile (J. Heintz, ODFW, pers. commun.).

d. Assessment of impact

(1) Detroit

Riparian hardwood, shrubland, and conifer forest cover types comprised the majority of the 5,059 acres evaluated as ruffed grouse habitat prior to project construction (Table 13). The suitability of this habitat was rated 7 (above average). The mix of forage areas, deciduous trees, and conifer forest for cover provided good habitat conditions. The relative value of the affected area for ruffed grouse prior to construction was 3,541 HU's.

Construction of the project resulted in the loss of 3,730 acres of ruffed grouse habitat, including 605 acres of riparian habitat and 1,002 acres of shrubland habitat (Table 13). The remaining habitat was rated 2 (poor) because of the preponderance of conifer forest and the degree of disturbance that had recently occurred. Small amounts of red alder and conifer-hardwood forest were available. The postconstruction value of 266 HU's represented a loss of 3,275 HU's from preconstruction conditions.

Revegetation and successional changes resulted in a net gain of 278 acres of ruffed grouse habitat from postconstruction to recent (1979) conditions (Table 13). This was due primarily to an increase in the marginal value habitat provided by closed sawtimber conifer forests. Evaluation of recent conditions in the project area indicated a rating of 3 (below average) for the 1,607 acres of habitat available at that time. Lack of riparian habitat and predominance of conifer forest were reasons for the below average habitat rating. Conifer-hardwood forest on the south side of Detroit Reservoir provided some ruffed grouse habitat. The 482 HU's calculated for the recent conditions represented a loss of 3,059 HU's from preconstruction conditions.

(2) Big Cliff

Habitat available to ruffed grouse prior to construction consisted of 319 acres, rated 4 (below average) (Table 14). Conifer forest and riparian hardwood cover types provided cover, although the area was generally steep and not attractive to ruffed grouse. The value of the preconstruction habitat was 128 HU's.

The 50 acres remaining after construction (1956) were given a minimum rating of 1, for a value of 5 HU's (Table 14). By 1979, 156 acres of ruffed grouse habitat were available. A small amount of hardwoods and foraging habitat was present and a rating of 3 (below average) was given. The 47 HU's available in 1979 represented a loss of 81 HU's from preconstruction conditions.

(3) Summary of impacts

The Detroit Project resulted in the loss of 3,615 acres and 3,140 HU's for ruffed grouse. The decline in HU's represents a loss in the potential of the project area to support grouse and other wildlife species with similar habitat preferences or requirements.

Table 13. Ruffed grouse: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	526	0	0	-526	-526
Temperate conifer forest, closed pole	403	65	43	-338	-360
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian shrub	27	0	5	-27	-22
Riparian hardwood	578	0	0	-578	-578
Shrubland	1,046	44	63	-1,002	-983
Grass-forb	297	207	27	-90	-270
Red alder	233	39	24	-194	-209
Agricultural, cropland	22	0	0	-22	-22
Agricultural, pasture	23	0	0	-23	-23
TOTAL ACRES	5,059	1,329	1,607	-3,730	-3,452
Habitat Rating	7	2	3		
HABITAT UNITS	3,541	266	482	-3,275	-3,059

Table 14. Ruffed grouse: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	9	0	5	-9	-4
Temperate conifer forest, closed pole	30	2	2	-28	-28
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Shrubland	21	15	17	-6	-14
Grass-forb	25	14	27	-11	+2
Red alder	82	10	59	-72	-23
TOTAL ACRES	319	50	156	-269	-163
Habitat Rating	4	1	3		
HABITAT UNITS	128	5	47	-123	-81

7. Pileated woodpecker

a. Importance

The pileated woodpecker is a primary cavity excavator. Vacated woodpecker cavities are used by many birds and mammals for reproduction, roosting, shelter, or hibernation (Bull and Meslow 1977). The pileated woodpecker was chosen as a target species because of its preference for old-growth and mature forest habitat, to represent species which use those cover types, and because of impacts which occurred as a result of the project.

b. Habitat requirements

Pileated woodpeckers in western Oregon find optimum habitat for nesting and foraging in old-growth Douglas-fir forests (Meslow et al. 1981). Pileated woodpeckers also nest in true fir and deciduous trees (Bent 1964, Conner et al. 1975). Critical habitat components are large snags, large trees, diseased trees, dense forest stands, and high snag densities (Bull 1975). Pileated woodpeckers prefer to nest in Z-storied stands with a crown closure of approximately 70% and in trees or snags with a dbh greater than 20 inches (Bull 1975, Bull and Meslow 1977, Schroeder 1983).

Foraging habitats of pileated woodpeckers contain high densities of logs and snags, dense canopies, and tall shrub cover. Carpenter ants and their larvae, and other wood-boring insects are the primary food items of pileated woodpeckers (Bull 1975).

C. History in the project area

Information was not available on populations of pileated woodpeckers during the preconstruction period. It may be assumed, however, that because old-growth and mature conifer forests were more plentiful in the project area prior to project construction, pileated woodpecker populations were larger than at present.

d. Assessment of impact

(1) Detroit

The project area prior to construction contained 3,644 acres of habitat available to pileated woodpeckers (Table 15). Fires had created snags and log debris for foraging, although nesting habitat was not plentiful. The habitat suitability was rated 4 (below average) for a preconstruction value of 1,458 HU's.

After construction of Detroit Dam and Reservoir (1956), 1,078 acres of habitat were available. Foraging conditions were adequate but nest sites were limited. The general suitability of the habitat was poor and rated 2. The 216 HU's available in 1956 represented a loss of 1,242 HU's from preconstruction conditions.

Table 15. Pileated woodpecker: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	526	0	0	-526	-526
Temperate conifer forest, closed pole	403	65	43	-338	-360
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian hardwood	578	0	0	-578	-578
Red alder	233	39	24	-194	-209
TOTAL ACRES	3,644	1,078	1,512	-2,566	-2,132
Habitat Rating	4	2	2		
HABITAT UNITS	1,458	216	302	-1,242	-1,156

The suitablity of the 1,512 acres of habitat available in 1979 was essentially the same as at postconstruction and was rated 2 (poor), yielding a value of 302 HU's for the recent habitat conditions. Habitat value for pileated woodpeckers declined by 1,156 HU's from preconstruction to 1979.

(2) Big Cliff

The 273 acres of habitat available to pileated woodpeckers at the Big Cliff site prior to project construction were rated 3 (below average) for a value of 82 HU's (Table 16). Snags and downed logs within the affected area had some value for nesting and foraging.

Habitat remaining after construction (1956) and in 1979 consisted of 21 and 112 acres, respectively (Table 16). The suitability of the habitat at both periods was minimal and rated 1. The few remnant snags available may have received some incidental use. As a result of project construction, the value of habitat for pileated woodpeckers decreased by 80 HU's from preconstruction to postconstruction (1956) and by 71 HU's from preconstruction to 1979.

(3) Summary of impact

Pileated woodpeckers lost 1,227 HU's and 2,293 acres of habitat as a result of the Detroit Project. The decline in HU's for pileated woodpeckers at the Detroit and Big Cliff sites represents a loss in the potential of the project area to support pileated woodpeckers and other wildlife species with similar habitat preferences or requirements.

8. Northern spotted owl

a. Importance

The northern spotted owl is currently classified by ODFW as "threatened" in Oregon. Populations in Oregon appear to be declining as old-growth conifer forests are gradually eliminated (Forsman et al. 1985). The spotted owl is frequently used as an indicator species in the Pacific Northwest because it is sensitive to land use actions affecting old-growth forests. The spotted owl was chosen as a target species because of its threatened status, management emphasis within Oregon, dependence on old-growth forests, and to represent the group of species which find optimum habitat in old-growth forests.

b. Habitat requirements

Recent studies in western Oregon identified old-growth forests as required habitat for spotted owls (Forsman et al. 1977, 1984). Ninety-eight percent of the pairs located by Forsman et al. (1984) were found in unlogged old-growth forests (>200 years old) or in mixed forests of old-growth and mature timber. Nesting habitat is provided by multi-layered (uneven-aged) old-growth forests. Most spotted owl nests in western Oregon are located in cavities in old-growth conifers; others occur on platforms in mature or old-growth conifers (Forsman et al. 1984). Nests are typically found within 1,000 feet of a spring or small

Table 16. Pileated woodpecker: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open pole	9	0	5	-9	-4
Temperate conifer forest, closed pole	30	2	2	-28	-28
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
Red alder	82	10	59	-72	-23
TOTAL ACRES	273	21	112	-252	-161
Habitat Rating	3	1	1		
HABITAT UNITS	82	2	11	-80	-71

stream. Spotted owls also prefer old-growth forests for roosting (more than 90% of the time), possibly because these forests provide protection under most weather conditions (Forsman et al. 1984).

Radio-tagged owls on the west slope of the Cascade Mountains show a strong preference for foraging in unlogged old-growth forests (Forsman et al. 1984). Second-growth forests older than 25-35 years of age provide marginal foraging habitat. The diet of spotted owls varies seasonally, with a variety of mammals, birds, and insects consumed. Mammals comprise 92% of all prey taken (Forsman et al. 1984). During fall and winter, the primary prey of spotted owls in forests of Douglas-fir and western hemlock are northern flying squirrels. During spring and summer, snowshoe hares, shrews, pocket gophers, red tree voles, western red-backed voles, small birds, and insects become increasingly common in the diet (Forsman et al. 1984).

C. History in the project area

Spotted owls were historically thought to be uncommon or rare throughout their range because they inhabit dense forests and were seldom observed (Forsman et al. 1985). Prior to the late 1960's, techniques did not exist which allowed the collection of reliable population data (Forsman et al. 1984). It may be assumed, however, that historically the acreage of old-growth forest was greater and consequently, spotted owl populations were larger than they are now. One spotted owl management area (SOMA) is located near the Breitenbush arm on the north side of Detroit Reservoir and another SOMA occurs about 1 mile east of the reservoir.

d. Assessment of impact

(1) Detroit

Habitat available to spotted owls in the affected area prior to project construction consisted of 1,875 acres, 204 acres of which were old-growth conifer forest (Table 17). The suitability of the habitat for spotted owls was assessed a rating of 2 (poor), yielding 375 HU's. Much of the old-growth forest adjacent to the project site on the north and east sides had either been burned or logged before construction. The closed sawtimber conifer forest may have provided marginal foraging habitat for owls inhabiting old-growth stands south and west of the reservoir site.

Construction of the project (1956) resulted in the loss of 1,054 acres of potential spotted owl habitat. The marginal habitat present at post-construction was rated 1 (low) and valued at 82 HU's.

In 1979 the habitat was similarly rated 1, but an increase in acres of closed sawtimber conifer forest resulted in a value of 129 HU's. This represented a loss of 246 HU's for spotted owls from preconstruction to 1979.

Table 17. Northern spotted owl: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
TOTAL ACRES	1,875	821	1,288	-1,054	-587
Habitat Rating	2	1	1		
HABITAT UNITS	375	82	129	-293	-246

(2) Big Cliff

The spotted owl was not used as a target species at Big Cliff because the evaluation team did not feel there was adequate habitat present at the site.

(3) Summary of impact

As a result of the Detroit Project, spotted owls lost 246 HU's and 587 acres of habitat. The decline in HU's at the Detroit site represents a loss in the potential of the project area to support spotted owls and other wildlife species with similar habitat preferences or requirements.

9. Bald eagle

a. Importance

The bald eagle is classified by ODFW and USFWS as "threatened" in Oregon. The Pacific States Bald Eagle Recovery Team (1982) set recovery goals for bald eagle populations in Oregon and identified Detroit Reservoir as a potential nesting area. Potential nesting areas were determined by historical nest records, occasional sightings of adult eagles, and/or presence of old-growth forests within 1 mile of a water body possessing a good supply of fish and/or waterfowl. The bald eagle was chosen as a target species because of its threatened status, management emphasis within Oregon, and because bald eagles may have benefited from construction of the Detroit Project.

b. Habitat requirements

Bald eagles find optimum nesting and roosting habitat in old-growth forests (Meslow et al. 1981). In western Oregon, Douglas-fir is the most frequently used tree species for nesting (Anthony et al. 1982). Tree structure and uneven-aged forest stands appear to be more important, however, than tree species in the selection of nest trees. Nest trees are typically the largest tree in the stand and are usually located within 1 mile of large bodies of water (Anthony et al. 1982). Winter roosting sites are characterized by a protected microclimate, stout perches high above the ground, a clear view of surrounding terrain, and freedom from human activity (Stalmaster et al. 1985). Bald eagles use both deciduous roosts in riparian habitat and coniferous roosts for protection from adverse weather (Stalmaster and Newnan 1979). Bald eagles use mature or old-growth roost trees that are larger than the average size of surrounding trees (Hansen et al. 1980, Keister 1981, Anthony et al. 1982).

Bald eagles forage in open areas, usually associated with rivers, lakes, or coastal shorelines (Stalmaster et al. 1985). The Pacific States Bald Eagle Recovery Team (1982) stated that food supply is probably the most critical component of bald eagle wintering habitat in the Pacific Region. The most common foods of eagles in this region include fish, waterfowl, and carrion. Anadromous fish, trout, whitefish, squawfish, carp, suckers, and tui chubs are used by eagles (Pacific States Bald Eagle Recovery Team 1982). Waterfowl are an important food item for

eagles in the Klamath Basin (Keister 1981) and at some reservoirs on the Columbia River (Fielder 1982). Studies in Washington (Servheen 1975, Stalmaster 1976) identified mammalian carrion as an important alternate food source. Because the young are less tolerant of food deprivation than adults, a constant food supply is most important during the nesting season (Stalmaster et al. 1985).

Perching sites are another important feature of bald eagle habitat. Proximity to food is the primary factor governing selection of perching sites (Steenhof et al. 1980). Optimum perching sites at feeding areas are trees located close to water and characterized by exposed lateral limbs (Stalmaster et al. 1985). Perches may also be used as "sentry" sites by breeding adults for defending the nest. Snags, when near the nest tree, are preferred perching locations during the nesting season (Forbis et al. cited in Stalmaster et al. 1985).

C. History in the project area

Information was not available on the status of bald eagle populations in the project area prior to construction. Two adult eagles and 1 immature eagle were observed in the Detroit Reservoir area during the 1982 mid-winter bald eagle survey. Two adult eagles were observed during the 1983 and 1984 surveys. Approximately 10 eagles use the area around Big Cliff Reservoir during winter.

d. Assessment of impact

(1) Detroit

Before construction of Detroit Dam and Reservoir, the affected area contained 2,850 acres of bald eagle habitat (Table 18). This habitat was rated 5 (average) by the evaluation team, indicating 1,425 HU's were available. Anadromous fish provided a food base for part of the year, but nest sites were few or lacking.

Construction of the project (1956) resulted in the loss of 1,558 acres of terrestrial habitat potentially used by bald eagles for nesting and perching (Table 18). The project eliminated 310 acres of river and created 3,580 acres of reservoir habitat used by bald eagles for foraging. Increased human access resulting from the project may have caused disturbance to feeding, nesting, or roosting bald eagles. The suitability of the habitat in 1956 was rated 2 (poor) because of the general habitat disturbance and because the fish prey base had not yet recovered. The 912 HU's represented a loss of 513 HU's from pre-construction conditions.

By 1979, 5,033 acres of bald eagle habitat were present in the affected area (Table 18) and that habitat was rated 5 (average). Although no active nest sites were identified, potential areas were available. Fish populations were more than adequate but recreational disturbance lowered the habitat quality somewhat. From preconstruction to 1979, approximately 1,092 HU's for bald eagles were gained.

Table 18. Bald eagle: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian hardwood	578	0	0	-578	-578
Sand/gravel/ cobble	50	0	0	-50	-50
River	318	8	8	-310	-310
Reservoir	0	3,580	3,580	+3,580	+3,580
TOTAL ACRES	2,850	4,562	5,033	+1,712	+2,183
Habitat Rating	5	2	5		
HABITAT UNITS	1,425	912	2,517	-513	+1,092

(2) Big Cliff

The affected area contained 234 acres of habitat available to bald eagles prior to construction (Table 19). Anadromous fish were available as a food source; however, the evaluation team determined the suitability of the habitat to be 3 (below average) for a value of 70 HU's in 1939.

Construction of Big Cliff Reservoir resulted in the loss of 143 acres of terrestrial habitat and 72 acres of river, and created 141 acres of reservoir. A net total of 160 acres of potential bald eagle habitat was available at postconstruction (Table 19). The evaluation team rated the habitat 2 (poor) due to the reduction in the fish prey base and disturbance of vegetation within the affected area. The 32 HU's of bald eagle habitat available in 1956 represented a loss of 38 HU's from preconstruction conditions.

The 197 acres of potential bald eagle habitat within the affected area in 1979 were rated 5 (average), indicating a value of 99 HU's (Table 19). Although anadromous fish runs no longer existed, small populations of waterfowl were available as prey. The site supports a small winter population of bald eagles that utilize perch sites below the dam. Big Cliff Reservoir resulted in a gain of 29 HU's for bald eagles from 1939 to 1979.

(3) Summary of impacts

The Detroit Project resulted in the loss of 1,701 acres of terrestial habitat potentially used by bald eagles for nesting and perching. The project eliminated 382 acres of river and created 3,721 acres of reservoir used for foraging. The gain of 1,121 HU's for bald eagles primarily represents an increase in the potential of the project area to provide foraging requirements of eagles.

10. Osprey

a. Importance

The osprey is included on the USFWS (1982) list of national species of special emphasis and was chosen as a target species because of management interest within Oregon, and because this species may have benefited from construction of the Detroit Project.

b. Habitat requirements

Ospreys inhabit mid- to late-stage forests near lakes or large rivers. Nests are usually located within a mile of water (Koplin 1971). Nests are most commonly on the top of partially or completely dead trees ranging in height from 50-250 feet (French and Koplin 1972). Lind (1976) reported an average height of 120 feet and average dbh of 43 inches for osprey nest trees adjacent to Crane Prairie Reservoir, Oregon. In addition to the nest tree, at least one other large tree within 150 yards of the nest is regularly used by the nesting pair and fledglings for sunning, protection from wind, and as a "lookout" perch

Table 19. Bald eagle: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
River	82	10	10	-72	-72
Reservoir	0	141	141	+141	+141
TOTAL ACRES	234	160	197	-74	-37
Habitat Rating	3	2	5		
HABITAT UNITS	70	32	99	-38	+29

and feeding post (Lind 1976, Zarn undated). Ospreys require open and clear water for foraging. Their diet is almost exclusively fish, generally 6-12 inches in length (Lind 1976).

C. History in the project area

Information was not available on osprey populations during the pre-construction period. In 1976, Henny et al. (1978) identified 1 nesting pair at Detroit Reservoir. There are currently 8 osprey nests near Detroit Reservoir, 7 of which are active (C. Bruce, ODFW, pers. commun.).

d. Assessment of impact

(1) Detroit

Prior to construction of Detroit Dam and Reservoir, the affected area contained 2,850 acres of potential osprey habitat, one-third of which was closed sawtimber conifer forest (Table 20). The interagency evaluation group considered the site to be above average in suitability and rated it 7, for a value of 1,995 HU's. Snags were available for nesting, and the prey base of anadromous and resident fish was plentiful.

Immediately following construction of Detroit Dam and Reservoir, 4,562 acres of habitat were available to ospreys, a gain of 1,712 acres (Table 20). The habitat was below average in suitability and was rated 4 by the evaluation team, primarily due to the impact of the project on the fish population. Ospreys were nesting at nearby natural lakes, and nest sites were available at Detroit. A loss of 170 HU's occurred as a result of the project.

Conditions at Detroit in 1979 indicated excellent potential for ospreys, limited only by the small number of snags for nesting, and recreational disturbance. -The evaluation team rated the 5,033 acres within the affected area 8 (high), for a value of 4,026 HU's, a gain of 2,031 HU's from preconstruction conditions to the recent period.

(2) Big Cliff

Ospreys had 234 acres of potential habitat within the project area before construction (Table 21). Anadromous fish were available as prey, although the highway created a disturbance along the north side of the river. The suitability of preconstruction habitat was rated 3 (below average) by the evaluation team, resulting in 70 HU's.

Potential osprey habitat within the affected area was reduced by 74 acres following construction of Big Cliff (Table 21). Although a few more snags were available for nesting, the fish population had not yet become reestablished and the suitability of the habitat was rated 2 (poor) by the evaluation team for a value of 32 HU's. This was a loss of 38 HU's from preconstruction conditions.

Table 20. Osprey: Acres of habitat available and lost, habitat ratings, and habitat units at Detroit Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open sawtimber	661	235	179	-426	-482
Temperate conifer forest, closed sawtimber	1,010	550	1,082	-460	+72
Temperate conifer forest, old-growth	204	36	27	-168	-177
Conifer-hardwood forest, open	0	45	51	+45	+51
Conifer-hardwood forest, closed	29	108	106	+79	+77
Riparian hardwood	578	0	0	-578	-578
Sand/gravel/ cobble	50	0	0	-50	-50
River	318	8	8	-310	-310
Reservoir	0	3,580	3,580	+3,580	+3,580
TOTAL ACRES	2,850	4,562	5,033	+1,712	+2,183
Habitat Rating	7	4	8		
HABITAT UNITS	1,995	1,825	4,026	-170	+2,031

Table 21. Osprey: Acres of habitat available and lost, habitat ratings, and habitat units at Big Cliff Reservoir.

Cover Type	Pre-construction (1939)	Post-construction (1956)	Recent (1979)	Net loss or gain (-, +) Pre- to Post-construction	Net loss or gain (-, +) Preconstruction to recent
Temperate conifer forest, open sawtimber	18	0	2	-18	-16
Temperate conifer forest, closed sawtimber	114	4	27	-110	-87
Conifer-hardwood forest, closed	0	5	17	+5	+17
Riparian hardwood	20	0	0	-20	-20
River	82	10	10	-72	-72
Reservoir	0	141	141	+141	+141
TOTAL ACRES	234	160	197	-74	-37
Habitat Rating	3	2	5		
HABITAT UNITS	70	32	99	-38	+29

The 197 acres of potential osprey habitat available at the recent period represent a loss of 37 acres from preconstruction conditions (Table 21). Water quality was good, as was the prey base, and perch sites were available. Snags for nesting were not available in any quantity, and the deep reservoir with steep banks was not a good foraging area. The evaluation team considered the suitability of the habitat average and rated it 5, for a value of 99 HU's, representing a gain of 29 HU's for ospreys from preconstruction to recent conditions.

(3) Summary of impacts

As was indicated for bald eagles, the Detroit Project eliminated 1,701 acres of terrestrial habitat potentially used for nesting and perching. Changes in foraging habitat involved the loss of 382 acres of river and the gain of 3,721 acres of reservoir. The increase of 2,060 HU's for ospreys primarily represents an increase in the potential of the project area to provide foraging requirements.

V. SUMMARY

The Detroit Project inundated, extensively altered, or affected 6,324 acres of land and river in the North Santiam River drainage (Tables 1, 2). Impacts to wildlife centered around the loss of 1,608 acres of conifer forest and 620 acres of riparian habitat. Nineteen vegetation or land use cover types were identified within the area directly affected by construction and operation of the hydroelectric-related components of the project. Acreages of each cover type were calculated for 3 time periods: prior to project construction (1939), directly after construction (1956), and more recently (1979).

Project impacts were evaluated for 10 wildlife species or species groups selected from a list of species likely to occur in the project area (Appendix A). A habitat based evaluation system was used to assess the suitability of preconstruction, postconstruction, and recent habitat for the target species or species groups. Losses or gains to these species as a result of the hydroelectric-related components of the Detroit Project were calculated and are summarized in Tables 22 and 23. Impacts resulting from the Detroit Project included the loss of winter range for Roosevelt elk and black-tailed deer and the loss of year-round habitat for deer, river otter, beaver, ruffed grouse, pileated woodpecker, spotted owl, and many other wildlife species. Bald eagle and osprey were benefited by an increase in foraging habitat.

Impacts to target species were measured by determining the difference between habitat units (HU's) prior to construction and after construction. HU's are a measure of the quantity (habitat area) and quality (suitability) of available habitat. One HU is equivalent to 1 acre of optimum habitat. In most cases the losses in HU's were greater immediately following project construction than when measured 23 years after completion of the project because of natural revegetation in the portion of affected area which was not inundated. These differences are discussed in the target species sections of the report. To simplify the summary table, however, only losses or gains which occurred from preconstruction to the more recent condition were addressed. The habitat

units lost or gained (Tables 22 and 23) represent the change in the potential of the habitat to support the given species at one point in time. That potential, however, was lost over the entire life of the project, a point which should be remembered when planning mitigation. It should also be noted that HU's lost or gained are not totaled among species. Each species was evaluated separately. When mitigation, enhancement, or protection measures are conducted, a single activity may improve the habitat for more than one species and would be credited for doing so. If it is not possible to mitigate in-kind (for the same species which experienced losses), out-of-kind mitigation, and hence trade-off mitigation, may have to be negotiated. Benefits to bald eagles and ospreys, for example, may be credited against losses to other species during the process of establishing trade-off mitigation levels.

In most cases it was not practical or possible to estimate the number of animals lost or gained as a result of the project. Site specific wildlife population estimates prior to construction were not available. Density estimates by OSGC were available for the North Santiam River drainage in 1948 for deer and grouse, but these figures were generalized and not representative of the actual losses which occurred at the Detroit Project. For example, density estimates for deer do not reflect the level of use the project area might have received during severe winter conditions and, thus, its long term importance to the deer population in the drainage. The Detroit site was considered by the evaluation team to be above average ruffed grouse habitat, which may have supported a higher density of grouse than indicated by the average estimate for the drainage. The technique used in 1948 to estimate deer and grouse densities was not documented. Possibly the factor which most complicates the attempt to estimate the number of animals lost or gained as a result of the Detroit Project is the considerable change in conditions for wildlife in the Willamette Basin caused by timber harvest and increased human use. The number of animals using the site at a given time does not adequately reflect the level of project impact because population fluctuations have occurred as a result of other factors. The potential of the affected area to support wildlife was altered as a result of the project and that change can be quantified in terms of HU's.

Impacts considered in this report were limited to effects of construction and operation of the hydroelectric-related components of the Detroit Project unless otherwise stated. These impacts would have occurred even if the project was not used for flood control or other nonhydroelectric purposes. Quantitative impacts considered were limited to the area directly affected by the project. Cumulative or system-wide impacts were not quantitatively assessed. Losses of wildlife and wildlife habitat resulting from increased human development as a result of the Willamette Reservoir System were not addressed. Indirect impacts such as degredation of habitat adjacent to the project site as a result of increased human development, recreational use, or blockage of anadromous fish passage were not measured.

Table 22. Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of Detroit Reservoir, North Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units[ab] lost or gained	Estimated No. animals lost or gained	Impacts
BIG GAME				
Roosevelt elk	-3,445	-2,210	unknown	Loss of winter habitat. Migration and movement inhibited or blocked. Increased disturbance.
Black-tailed deer	-3,445	-3,061	unknown	Loss of year-round habitat. Migration and movement inhibited or blocked. Increased disturbance,
FURBEARERS				
River otter	-676	-882	unknown	Loss of year-round habitat. Movement inhibited or blocked.
Beaver	-927	-715	unknown	Loss of year-round habitat. Movement inhibited or blocked.
WATERFOWL				
Common merganser	+2,745	+1,176	unknown	Loss of breeding habitat. Additional migratory resting habitat provided.
UPLAND GAME				
Ruffed grouse	-3,452	-3,059	unknown	Loss of year-round habitat. Increased disturbance,

a From preconstruction (1939) to recent (1979).
b This number represents losses or gains at one point in time, not over the life of the project.

Table 22. (cont'd.) Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of Detroit Reservoir, North Santiam River, Oregon,

Species (group)	Acres of habitat lost or gained[a]	Habitat Units[ab] lost or gained	Estimated No, animals lost or gained	Impacts
NONGAME SPECIES				
Pileated woodpecker	-2,132	-1,156	unknown	Loss of year-round habitat. Increased disturbance.
Spotted owl	-587	-246	unknown	Loss of foraging habitat. Movement probably inhibited. Increased disturbance.
Bald eagle	+2,183	+1,092	unknown	Loss of nesting and roosting habitat, Increased disturbance, Foraging habitat increased,
Osprey	+2,183	+2,031	unknown	Loss of nesting and perching habitat. Increased disturbance. Foraging habitat increased,

a From preconstruction (1939) to recent (1979).
b This number represents losses or gains at one point in time, not over the life of the project.

Table 23. Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of Big Cliff Reservoir, North Santiam River, Oregon.

Species (group)	Acres of habitat lost or gained[a]	Habitat Units[ab] lost or gained	Estimated No, animals lost or gained	Impacts
BIG GAME				
Roosevelt elk	-173	-81	unknown	Migration and movement inhibited or blocked. Increased disturbance.
Black-tailed deer	-173	-81	unknown	Loss of winter habitat. Migration and movement inhibited or blocked. Increased disturbance.
FURBEARERS				
River otter	+43	-38	unknown	Loss of year-round habitat. Movement inhibited or blocked.
Beaver	-63	-50	unknown	Loss of year-round habitat. Movement inhibited or blocked.
WATERFOWL				
Common merganser	+66	-11	unknown	Loss of breeding habitat. Additional migratory resting habitat provided. Increased disturbance.
UPLAND GAME				
Ruffed grouse	-163	-81	unknown	Loss of year-round habitat. Increased disturbance.

a From preconstruction (1939) to recent (1979).
b This number represents losses or gains at one point in time, not over the life of the project.

Table 23. (cont'd.). Summary of impacts (preconstruction to recent) to target species as a result of the hydroelectric-related components of Big Cliff Reservoir, North Santiam River, Oregon,

Species (group)	Acres of habitat lost or gained[a]	Habitat Units[b] lost or gained	Estimated No. animals lost or gained	Impacts
NONGAME SPECIES				
Pileated woodpecker	-161	-71	unknown	Loss of year-round habitat, Increased disturbance.
Bald eagle	-37	+29	unknown	Loss of nesting and roosting habitat, Increased disturbance. Foraging habitat increased.
Osprey	-37	+29	unknown	Loss of nesting and perching habitat, Increased disturbance. Foraging habitat increased.

a From preconstruction (1939) to recent (1979).
b This number represents losses or gains at one point in time, not over the life of the project.

No documentation was found nor were resource agency personnel aware of any mitigation, enhancement, or protection measures implemented by USACE at the Detroit Project to offset impacts to wildlife resulting from construction or operation of the project (Bedrossian et al. 1984).

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APPENDIX A

WILDLIFE SPECIES POTENTIALLY OCCURING IN THE DETROIT/BIG CLIFF DAM AND RESERVOIR PROJECT AREA[1]
(PRECONSTRUCTIONAND/ORPOSTCONSTRUCTION

Herptiles

Northwestern salamander
Long-toed salamander
Cope's giant salamander
Pacific giant salamander
Olympic salamander
Clouded salamander
Oregon slender salamander
Ensatina
Dunn's salamander
Larch mountain salamander
Western redback salamander
Roughskin newt
Western toad
Pacific tree frog
Tailed frog
Red-legged frog
Foothill yellow-legged frog
Cascade frog
Bullfrog
Spotted frog
Western pond turtle
Northern alligator lizard
Short-horned lizard
Western fence lizard
Western skink
Rubber boa
Racer
Sharptail snake
Ringneck snake
Gopher snake
Western terrestrial garter snake
Northwestern garter snake
Common garter snake
Western rattlesnake

Birds

Common loon
Pied-billed grebe
Horned grebe
Red-necked grebe
Eared grebe
Western grebe
Double-crested cormorant
American bittern
Great blue heron
Great egret
Green-backed heron
Greater white-fronted goose
Canada goose
Wood duck
Green-winged teal
Mallard
Northern pintail
Blue-winged teal
Cinnamon teal
Northern shoveler
Gadwall
American wigeon
Canvasback
Redhead
Ring-necked duck
Greater scaup
Lesser scaup
Harlequin duck
Common goldeneye
Barrow's goldeneye
Bufflehead
Hooded merganser
Comnon merganser
Ruddy duck
Turkey vulture
Osprey
Bald eagle
Northern harrier
Sharp-shinned hawk
Cooper's hawk
Northern goshawk
Red-tailed hawk
Golden eagle
American kestrel
Merlin
Peregrine falcon
Prairie falcon
Ring-necked pheasant
Blue grouse
Ruffed grouse
California quail

1 Based on species list for reproductive habitat, Willamette National Forest and Oregon Nongame Wildlife Management Plan, review draft.

Birds (Continued)

Mountain quail
Virginia rail
Sora
American coot
Sandhill crane
Killdeer
Greater yellowlegs
Solitary sandpiper
Spotted sandpiper
Western sandpiper
Least sandpiper
Baird's sandpiper
Dunlin
Long-billed dowitcher
Common snipe
Wilson's phalarope
Ring-billed gull
Western gull
Black tern
Rock dove
Band-tailed pigeon
Mourning dove
Barn owl
Western screech owl
Great horned owl
Northern pygmy owl
Spotted owl
Barred owl
Great gray owl
Long-eared owl
Northern saw-whet owl
Common nighthawk
Black swift
Vaux's swift
Calliope hummingbird
Rufous hunmingbird
Allen's hummingbird
Belted kingfisher
Lewis' woodpecker
Red-breasted sapsucker
Williamson's sapsucker
Downy woodpecker
Hairy woodpecker
White-headed woodpecker
Three-toed woodpecker
Black-backed woodpecker
Northern flicker
Pileated woodpecker
Olive-sided flycatcher
Western wood pewee
Willow flycatcher
Hammond's flycatcher
Dusky flycatcher
Western flycatcher
Western kingbird
Horned lark
Purple martin
Tree swallow
Violet-green swallow
Northern rough-winged swallow
Bank swallow
Cliff swallow
Barn swallow
Gray jay
Steller's jay
Scrub jay
Clark's nutcracker
American crow
Comnon raven
Black-capped chickadee
Mountain chickadee
Chestnut-backed chickadee
Bushtit
Red-breasted nuthatch
White-breasted nuthatch
Pygmy nuthatch
Brown creeper
Rock wren
Canyon wren
Bewick's wren
House wren
Winter wren
Marsh wren
American dipper
Golden-crowned kinglet
Ruby-crowned kinglet
Western bluebird
Mountain bluebird
Townsend's solitaire
Swainson's thrush
Hermit thrush
American robin
Varied thrush
Wrentit
Water pipit
Bohemian waxwing
Cedar waxwing
European starling
Solitary vireo
Hutton's vireo
Warbling vireo
Red-eyed vireo
Tennessee warbler
Orange-crowned warbler

Birds (Continued)

Nashville warbler
Yellow warbler
Black-throated blue warbler
Yellow-runped warbler
Black-throated gray warbler
Townsend's warbler
Hermit warbler
American redstart
MacGillivray's warbler
Common yellowthroat
Wilson's warbler
Yellow-breasted chat
Western tanager
Black-headed grosbeak
Lazuli bunting
Green-tailed towhee
Rufous-sided towhee
Brown towhee
Chipping sparrow
Brewer's sparrow
Vesper sparrow
Savannah sparrow
Fox sparrow
Song sparrow
Lincoln's sparrow
Golden-crowned sparrow
White-crowned sparrow
Harris' sparrow
Dark-eyed junco
Red-winged blackbird
Western meadowlark
Brewer's blackbird
Brown-headed cowbird
Northern oriole
Rosy finch
Pine grosbeak
Purple finch
Cassin's finch
House finch
Red crossbill
White-winged crossbill
Pine siskin
Lesser goldfinch
American goldfinch
Evening grosbeak
House sparrow

Mammals

Virginia opossum
Vagrant shrew
Dusky shrew
Pacific shrew
Water shrew
Pacific water or Marsh shrew
Trowbridge's shrew
Shrew-mole
Townsend's mole
Coast mole
Little brown myotis
Yuna myotis
Long-eared myotis
Fringed myotis
Long-legged myotis
California myotis
Silver-haired bat
Big brown bat
Hoary bat
Townsend's big-eared bat
Pallid bat
Pika
Brush rabbit
Snowshoe hare
Mountain beaver
Yellow-pine chipmunk
Townsend's chipmunk
Siskiyou chipmunk
Yellow-bellied marmot
California ground squirrel
Golden-mantled ground squirrel
Western gray squirrel
Douglas' squirrel
Northern flying squirrel
Botta's pocket gopher
Western pocket gopher
Beaver
Deer mouse
Dusky-footed woodrat
Bushy-tailed woodrat
Western red-backed vole
Heather vole
White-footed vole
Red tree vole
Townsend's vole
Long-tailed vole
Creeping vole
Water vole
Muskrat
House mouse
Pacific jumping mouse
Porcupine
Nutria
Coyote
Red fox

Mammals (Continued)

Gray fox
Black bear
Marten
Fisher
Ermine
Long-tailed weasel
Mink
Wolverine
Badger
Western spotted skunk
Striped skunk
River otter
Mountain lion
Lynx
Bobcat
Roosevelt elk
Mule deer
Black-tailed deer

APPENDIX B

Interagency Habitat Evaluation Group
Detroit Project

Name	Agency
Geoff Dorsey	USACE
Larry Gangle	USFS
Ed Harshman	USFS
Hal Legard	USFS
Jim Noyes	ODFW
Mary Potter	ODFW
Neil TenEyck	ODFW
Pat Wright	USFWS

APPENDIX C

Comments

(1) State agency (ODFW)

(2) Federal agencies (USFWS and USFS)

No comments were received from USFS.

(3) Tribes

No tribes are involved with the actions taken at the Detroit Project.

(4) Facility operator (USACE)

BPA requested comments on the November 1985 Detroit/Big Cliff report by 31 December 1985. USACE had not submitted comments by 20 February 1986 when the final report was typed; therefore, USACE comments could not be incorporated into the report.

(5) Other (PNUCC)

ODFW Comments:

Department of Fish and Wildlife
506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

December 9, 1985

Mr. James R. Meyer
Division of Fish and Wildlife
Bonneville Power Administration
PO Box 3621
Portland, OR 97208

Dear Mr. Meyer:

The following comments respond to your request, dated 22 November 1985, to review the Loss Assessment Report for the Detroit-Big Cliff Project.

The Detroit-Big Cliff Loss Assessment presents an analysis of the impacts to wildlife and wildlife habitat resulting from the construction and operation of the hydroelectric-related components of the project. The Detroit-Big Cliff Project inundated, extensively altered, or directly affected 6,324 acres of land and river in the North Santiam River drainage. Impacts to wildlife centered around the loss of 1,608 acres of conifer forest and 620 acres of riparian habitat. Important Roosevelt elk winter range was lost, as was year-round habitat for black-tailed deer, furbearers, upland game birds, pileated woodpeckers, spotted owls, and many other wildlife species. Impacts of the project included: blockage or inhibition of animal migration or movement; loss of thermal and/or hiding cover; alteration of open area and cover interspersion; loss of breeding, parturition and/or rearing habitat; fragmentation of contiguous habitat; loss or alteration of available forage; loss of nesting, perching and/or roosting sites; and avoidance of the project area by wildlife during construction.

The Detroit-Big Cliff Loss Assessment clearly shows the potential of the area to support wildlife was altered as a result of the project. That change was quantified in terms of Habitat Units. In this study, the Habitat Units lost or gained represent the change in the potential of the habitat to support the given species, at one point in time. That potential, it should be emphasized, was lost over the entire life of the project. Habitat Units also may serve as a guide toward developing mitigation plans, as well as provide a method of measuring the success of mitigation implementation.

The Oregon Department of Fish and Wildlife has a legal mandate "To maintain all species of wildlife at optimum levels and prevent the serious depletion of any indigenous species," and "To develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife." In accordance with this mandate, the Oregon Department of Fish and Wildlife has a policy to request mitigation when losses to animal populations and habitat result from project construction and operation. These

Explanations or Modifications:

No explanations or report modifications necessary.

ODFW Comments (cont.):

policies are consistent with the Northwest Power Planning Act and Wildlife Program purpose "to protect, mitigate, and enhance fish and wildlife to the extent affected by the development and operation of any hydroelectric project of the Columbia River and its tributaries..."

In order to "protect, mitigate, and enhance" wildlife resources affected by hydroelectric generating facilities, it is necessary to develop and implement mitigation plans. The Detroit-Big Cliff Loss Assessment represents the beginning of the process to achieve mitigation for the impacts to the wildlife resource resulting from construction of the project. The next step in the Council's Wildlife Program is the preparation of mitigation plans. I strongly urge the participating agencies to move forward in implementing the Wildlife Program of the Northwest Power Planning Council. The Oregon Department of Fish and Wildlife is ready to take the lead in developing a mitigation plan for the Willamette Basin. Consultation and coordination with the appropriate agencies involved in the project will be an integral part of the process. The Northwest Power Planning Act and the Power Council's Fish and Wildlife Program have provided the opportunity to correct past misunderstanding and shortsightedness regarding wildlife resources affected by the development and operation of hydroelectric power in the Columbia River Basin. The Oregon Department of Fish and Wildlife wants to see that opportunity realized to the fullest degree possible in a timely, effective, and cost-efficient manner.

I appreciate your assistance in this program and look forward to working with you in a cooperative way to achieve our mutual objectives.

Sincerely,

John R. Donaldson, PhD
Director

D16-9
EMS Projects Misc.

Explanations or Modifications (cont.):

No explanations or report modifications necessary.

USFWS Comments:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference PW:mm

January 23, 1986

Mr. John Palensky, Director
Division of Fish and Wildlife
Attn: James Meyer
Bonneville Power Administration
P. O. Box 3621
Portland, Oregon 97208

Dear Mr. Palensky:

We have reviewed the draft loss statement reports for Green Peter/Foster and Detroit/Big Cliff hydroelectric projects. The following comments are being provided for inclusion in each of the final loss statements.

In our opinion, the reports are well written and adequately describe the on-site wildlife impacts of each project. A comprehensive evaluation, based on habitat supported by population data when available, was conducted by a diverse team of wildlife biologists familiar with the area's wildlife resources. Our agency actively participated in each evaluation and we believe the methods employed to identify the wildlife impacts at each project resulted in a fair and accurate analysis of project impacts.

It is important to note that during each of the evaluations, the impacts were identified on a concensus basis by the evaluation team. This format provided for a thorough discussion of impacts, both beneficial and adverse, and provided a forum for resolving differences in a manner mutually acceptable to each agency's team representative. To the best of our knowledge, the impacts identified in the loss statements accurately reflect both the discussions and decisions of the evaluation teams.

The evaluations did not address cumulative impacts that these and the other major Willamette Valley hydroelectric projects may have had on wildlife. We believe the extensive development that has occurred along the Willamette River's floodplain has significantly reduced a variety of wildlife habitats and related resources. In our opinion, that development and resultant wildlife losses would have been considerably less without the construction and operation of the aforementioned hydroelectric projects. Accordingly,

Explanations or Modifications:

No explanations or report modifications necessary.

USFWS Comments (cont.):

the Power Council, BPA, and the Corps of Engineers, together with the wildlife management agencies should address the cumulative impacts of the major Willamette Basin hydroelectric projects on wildlife.

In conclusion, we believe the magnitude of on-site wildlife losses identified in the loss statements for the Green Peter/Foster and Detroit/Big Cliff hydroelectric projects warrants that mitigation planning be initiated as early as possible as provided for in the Power Council's Fish and Wildlife Program. We are eager to assist in these efforts and look forward to the day when on-the-ground mitigation can be implemented.

Sincerely,

Roger E Tuckerstrasse

for Russell D. Peterson
Field Supervisor

cc:
~~Jim Noyes~~ ODFW
ARD-HR, Dick Giger

Explanations or Modifications (cont.):

No explanations or report modifications necessary.

PNUCC COMMENTS

PNUCC

PACIFIC NORTHWEST UTILITIES CONFERENCE COMMITTEE

December 27, 1985

Mr. James Meyer PJS
Fish & Wildlife Division
Bonneville Power Administration
1002 N.E. Holladay
P.O. Box 3621
Portland, Oregon 97208-3621

Dear Jim:

The Pacific Northwest Utilities Conference Committee (PNUCC) submits this letter in response to your request for comments on the Oregon Department of Fish and Wildlife draft Wildlife and Wildlife Habitat Loss Assessment at Detroit/Big Cliff Dam and Reservoir Project, North Santiam River, Oregon.

This loss assessment does not differ technically from the previous loss assessments for the other Willamette Basin federal projects. The comments in our earlier review letter, dated July 29, 1985, therefore, also apply to this document. The following points highlight our major concerns.

1. The data and information included in the report are insufficient to evaluate the validity of the results. The information is presented within the context of abstract indices and the models and data relating the indices to the conditions at the project are absent. For example, we were not able to determine from the report the site-specific ecological difference between a habitat suitability index, "HSI," of 5 and one of 6, or even between one of 8 and one of 2. The changes in "HSI" reported as resulting from the hydroelectric proportion of the projects may be legitimate, but we were not able to verify these results.

2. The results of the losses evaluation are presented as though they are based on quantified data, although the data and sampling schemes are not reported. Input during the consultations indicated that much of the information is quite subjective. We recognize that the time constraints during this assessment precluded a detailed quantification of the "losses" and question whether such a quantification would be possible even under ideal time and funding conditions. Our concern is not with the subjectivity, but rather with presenting the results as if they were rigorously quantified when, in fact, they are qualitative and subjective. The available information may accommodate a qualitative evaluation of "low," "moderate," and "high" impacts. However, we feel that further detail is inappropriate unless rigorous

Explanations or Modifications:

Habitat suitability indexes were derived from site visits, aerial photographs, vegetation maps, and biologists' knowledge of species habitat requirements. Group discussions and averaging agency representatives' ratings yielded habitat suitability indexes ranging from "low" to "optimum", expressed on a scale of 1-10. See Section III.E. for discussion of methods and rating criteria. The numeric rating system and resulting Habitat Units provide a method to credit mitigation, protection, or enhancement activities against project impacts.

PNUCC Comments (cont.):

3. No population data is included to support the "losses" reported in the document. We have found documentation* of increases in Willamette Basin populations for several of the "impacted" species during the 1950s and 1960s, the decades of and following construction of these dams. Black-tailed deer and Roosevelt elk were reported in 1969--15 years after completion of Detroit--as being at their highest populations since the 1930s. Several other target species populations were reported as "satisfactory" or "unaffected by development." The conflicting information between the "HEP" analysis in this report and the population trends is a serious concern.

PNUCC does not believe that the Willamette projects loss assessments provide information that justifies a major wildlife mitigation program in the basin. We continue to support the "good stewardship" protection policies of the project operator, the Army Corps of Engineers. Our position remains unchanged from that stated in our letter of August 14, 1985. Thank you for this opportunity to comment.

Sincerely,

Kathryn Kostow

Kathryn Kostow
Fish & Wildlife Analyst

*Pacific Northwest River Basins Commission - Willamette Basin Task Force. (1969) Willamette Basin: Comprehensive Study of Water and Related Land Resources. Ap. D: Fish and Wildlife.

KK:lp:1631

cc John Palensky - BPA
Pam Barrow - PNUCC
Martin Montgomery - NWPPC
Jim Noyes - ODFW
Mary Potter - ODFW

Explanations or Modifications (cont.):

Site-specific wildlife population estimates prior to construction were not available. Wildlife population fluctuations in the Willamette Basin have occurred as a result of several factors. Because density estimates can often be misleading indicators of habitat quality, we evaluated the changes in habitat potential. The potential of the Detroit Project effected area to support wildlife has been altered, and it will remain so for the life of the project.